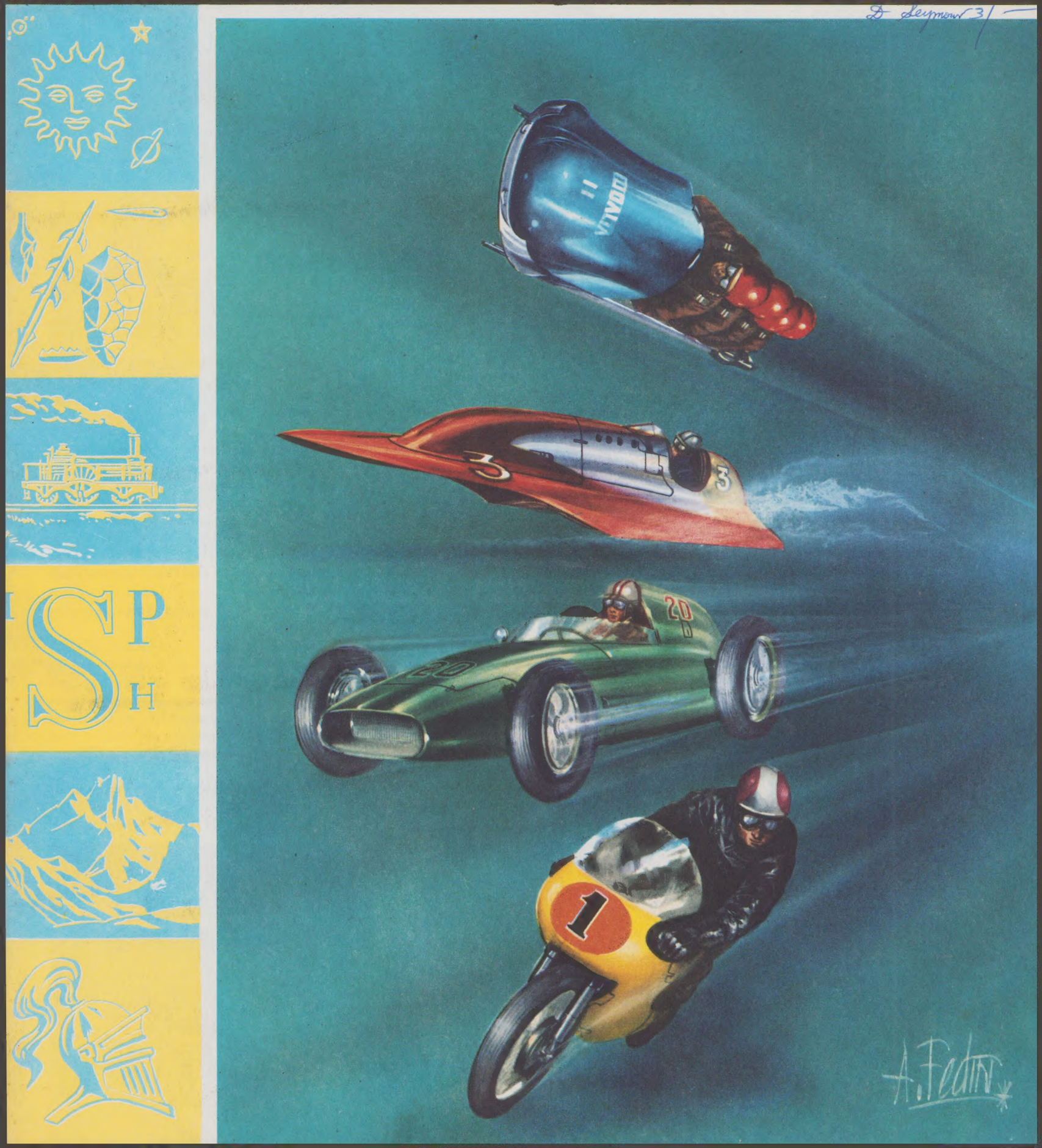
KNOWLEDGE

NO. 131 VOLUME 11 The colour magazine which grows into an encyclopaedia EVERY MONDAY 2/-



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SPORT (part three)

IN our last article on sport we are going to describe some of the sports that take place in and on water, then some of the winter sports, and, finally, some of the mechanised sports.

Swimming

Swimming was considered an important sport in the days of Greece and Rome, especially in the training of warriors, but after then it was scarcely practised at all until the 19th century, for it was feared that outdoor bathing helped to spread epidemics.

In early 19th-century swimming competitions the standard racing stroke was a form of side stroke with both arms under water throughout; this developed into the single overarm side stroke, and then into the double overarm or trudgeon, the forerunner of the crawl. The crawl, the fastest of all strokes, was practised in the South Sea islands long before it was adopted by the Australian swimmer Richard Cavill at the beginning of this century. The name was coined when a press account of Cavill's first demonstration of the stroke said that he appeared literally to crawl over the water.

There are two styles of breast stroke, the ordinary and the butterfly, neither of which is as fast as the crawl. They are distinguished by different arm strokes. In 1952 an alternative leg stroke for the butterfly style was introduced; instead of the traditional frog kick the swimmer could now move his legs in a fishtail or dolphin kick.

Among the most exciting swimming ventures have been the various attempts to swim the 22 miles from Dover to Calais across the English Channel. The first person to do this was Matthew Webb, an Englishman, in 1875.

If you are over 14 years of age, you are old enough to enter for a Bronze Medallion, the reward given by the Royal Life Saving Society to candidates who can show in a series of tests that, among other things, they have a thorough knowledge of the methods of release from the grip of a drowning person, and of bringing him safely to land. Candidates for this test have to swim 150 yards breast stroke and 150 yards back stroke without using their arms.

Diving

Diving is a sister sport of swimming, and is very popular at swimming galas.

Dives can be made either from a springboard or from a fixed board. In competition there are five types of dive which can be made from a springboard: a forward dive from forward take-off, backward dive from backward take-off, backward dive from forward take-off, forward dive from backward take-off, and a dive in which the body twists in addition to the forward or backward movement. Firm-board dives are similar to springboard dives, except that, in place of the twist dives, dives are made from a handstand take-off.

Skin diving

The most ancient form of diving is skin diving, which in the first place includes natural diving without any underwater breathing apparatus. This method is used by pearl and sponge divers all over the world.

After the Second World War, the term skin diving came to include diving with *self-contained underwater breathing apparatus* (often shortened to the initial letters SCUBA). The advantage of SCUBA is that the diver carries his own breathing gas strapped to his back, and because he is not connected to the surface by a lifeline or air hose, he can swim freely and explore where he wishes. There is, however, a limit to his supply of air, and for deep dives lasting a long time the suit-and-helmet kind of diving equipment is used, connected to the surface by an air hose. SCUBA equipment is generally inadvisable for dives deeper than 130 feet, but several descents to more than 300 feet have been made with it.

A diver in the middle of a complicated back-front pike dive

There are two kinds of SCUBA equipment: open-circuit and closed-circuit. Both systems were developed before 1880, and were improved for military purposes during the Second World War.

The first popular open-circuit SCUBA was developed by J. Y. Cousteau and E. Gagnan in 1943, who designed a type called the Aqua-Lung. The open-circuit usually uses compressed air as breathing gas, while the closed-circuit usually uses pure oxygen, and can not be used deeper than 30 feet.

Other items in the skin diver's equipment

A game of water polo; this fast-moving sport needs stamina, skill, and swimming ability

KNOWLEDGE NEWS

Week beginning 7th July 1963

TO SAVE ANIMALS HUMANS MUST HELP

The Wildlife Rangers badge

The Panda Club badge

THE Wildlife Youth Service is the junior branch of the World Wildlife Fund. Its object is to do everything possible to help the animals of the world. Boys and girls aged from 5 to 10 years can join the Panda Club (subscription is 2*s.* 6*d.* a year, including the badge and membership card). Young people aged between 11 and 18 (10½ years is accepted) can become members of the senior branch – the Wildlife Rangers. This costs 3*s.* a year, including membership card. The enamel Rangers badge costs 2*s.* So for 5*s.* you can be a full member of the Wildlife Rangers with badge and card.

The President of the Wildlife Youth Service is Peter Scott, and other executive officers include Sir Julian Huxley, John Chancellor, Armand Denis, Gerald Durrell, David Attenborough, Grahame Dangerfield, Harry Secombe, Eamonn Andrews, Bruce Forsyth and Johnny Morris.

If you want to join, please fill in the membership form at the bottom of page two. If you do not want to cut up your Knowledge News, just send the required information together with your postal order.

Cyril Littlewood, who is the director of the Wildlife Youth Service, will send you your membership card and badge. You will probably get to know him very well in the future. He is looking forward to making friends with many new members from among our readers.

THE WORLD'S WILDLIFE NEEDS YOU

CAN you remain inactive when animals are suffering, when whole species are threatened with extinction? This is the question the World Wildlife Fund asked the young people of Britain when the Wildlife Youth Service was launched recently. The answer came: it was an emphatic 'No!' Every day hundreds of applications for membership poured into the offices of the Wildlife Youth Service, together with enthusiastic letters.

If you want to help the world's wildlife, you too can join the Wildlife Youth Service. You will be helping the animals of the world in many ways. First you will be able to feel that you have swelled the numbers of an organisation that is really doing something to help threatened animals; this is the World Wildlife Fund. Secondly, you will be able to wear the badge of the Wildlife Rangers, or the Panda Club, and show that you have no intention of leaving wild animals to face pain, terror, and destruction. From the practical point of view the Youth Service can help you to learn more about natural history: by organising meetings in various parts of the country; by holding camps and field-study courses; and by arranging competitions and inter-school quiz contests.

The information service will be available to members free of charge, and will provide answers to all kinds of queries about wildlife.

If you want to join, please follow the instructions given at the top of this page.

A special message to Knowledge readers from two famous naturalists

Peter Scott writes:

I AM proud to be President of the Wildlife Youth Service. I hope as many Knowledge *readers as possible will join it. It is just as important for the young people as for adults to take an interest in wildlife. They are the inheritors of the world of tomorrow. But tomorrow may be too late to save our wild animals. I hope that your children will not say: 'Daddy, what was a wild animal?'*

Peter Scott

Armand Denis writes:

PEOPLE may say: 'We have millions of animals in the world today; thus what is the point of making such a fuss when just one species becomes extinct?' Let me tell you that although we still have plenty of animals in the world, they are decreasing at a rate much faster than at any time in the world's history. I know from personal experience that when today I see a herd of buffalo, only a few years ago I might have been looking at 10 *times as many.*

I hope as many readers of Knowledge *as possible will join the Wildlife Youth Service, and help to arouse public awareness of the plight of the animal kingdom.*

Armand Denis

In the Wildlife Youth Service you will make friends with and learn about both wild and domestic animals. (Above) Christine Brooks plays with a bear cub, and (right) Marion Hatton and Sandra Lloyd have a lesson in the care of the domestic cat. If you want to become members of the Wildlife Youth Service like these girls, see instructions at the top of this page.

Letter from the Editor

37 HERTFORD ST.
LONDON W.1

I HAVE recently been made a member of the National Committee of the Wildlife Youth Service. You can read all about the aims and the activities of this very worthwhile organisation on page one of *Knowledge News*, and if you feel as deeply as I do about the situation in the animal world, I hope you will join.

I cannot really add much to what my friends Peter Scott and Armand Denis have to say about the importance of the Youth Service; but I would like to stress that there *really* is a state of emergency in the animal world.

There is much that can be done to help animals – but little support for this work of conservation. We need more of the enthusiasm of a boy who recently wrote to say that he had sold his marbles to raise the money for his subscription to the Youth Service.

You can find details of membership and instructions about joining at the top of page one of *Knowledge News*. You do not have to send in the application form below if you do not want to cut up your *Knowledge News* – I know that many of you dislike doing this. Instead, you can just send a letter containing the required information and a postal order.

John Chancellor

APPLICATION FORM

To: Department KN, The Wildlife Youth Service, c/o 37 Hertford Street, London W.1.

Name .....

Address .....

.....

.....

School .....

Age .....

**Please enrol me as a member of the Wildlife Rangers (at a cost of 3s.).*

**Please send me the Wildlife Rangers badge (at a cost of 2s.).*

**Please enrol me as a member of the Panda Club and send me the Panda Club badge (at a cost of 2s. 6d.).*

***Please delete where necessary**

I enclose a postal order value

.....s. .....d.

IF YOU DO NOT WANT TO CUT UP YOUR KNOWLEDGE NEWS, SEND A LETTER CONTAINING THE INFORMATION REQUIRED BY THIS FORM TOGETHER WITH YOUR POSTAL ORDER.

THE LEANING TOWER IS FALLING DOWN

THE Leaning Tower of Pisa is falling down. It has indeed been falling since it was built nearly 800 years ago, but now, the experts say, the danger is imminent.

Professor Letterio Donato of Pisa University is the latest authority to sound the alarm about the famous tower. He has even produced a plan to save it by injecting reinforced concrete all round the base.

But the professor is only the latest of a long line of experts who have gazed at the tower's crazy angle and cried out for something to be done 'immediately'. One has only to examine the false alarms that have been given throughout the tower's history to realise that this famous Italian tourist attraction is probably more durable than the experts think.

Blown over

Before Donato, another professor claimed that the tower was 'in danger of falling at any instant . . . even a particularly strong gust of wind could cause its collapse'.

But this professor was speaking in July 1910 . . . nearly 53 years ago!

And between then and now reports of the tower's imminent collapse have appeared regularly in the world's newspapers.

So what is the truth of the matter? It might be as well to look at the history of the building of the tower, which is 177 feet high, and is at present leaning about 16½ feet out of the perpendicular.

The building (a *campanile* or bell-tower) was begun by Signor Bonanno of Pisa in the latter part of the 12th century. But Signor Bonanno never completed his task. The tower began to lean soon after the first few storeys had been built, for the foundations were only 10 feet deep and were no larger than the tower's circumference. When the 'list' was noticed, work was stopped and nearly 100 years went past before work was resumed.

Built-in lean

Then, as no further movement had taken place, it was deemed safe to go on. So when the tower was eventually completed it already had a built-in lean.

Admittedly it has leaned further since it was built. In fact, the marble spiralled tower is reckoned to lean about one-thirtieth of an inch every year.

So what is to be done? No one knows yet. Hundreds of solutions have been suggested over the years. Commissions have reported their rather obvious findings in thousands of words.

Sports car split

Some time ago, two Frenchmen took it upon themselves to solve the whole problem. They drove a high-powered sports car to the base of the tower and fixed a heavy cable to the side that leans away from the perpendicular. Then they jumped into their car and drove off at high speed. All that happened was that the car split in two.

There is also the commercial side of the picture. The Tower of Pisa is an important national asset to the Italians. Every year, more than 70,000 tourists climb the 293 winding stairs to the summit where Galileo once experimented, dropping weights to demonstrate the force of gravity.

It would be a disaster for Pisa if the tower fell down – but will it? It has survived storms and earthquakes over the centuries, and in the last war it even survived several bombardments when high-explosive shells landed all round it.

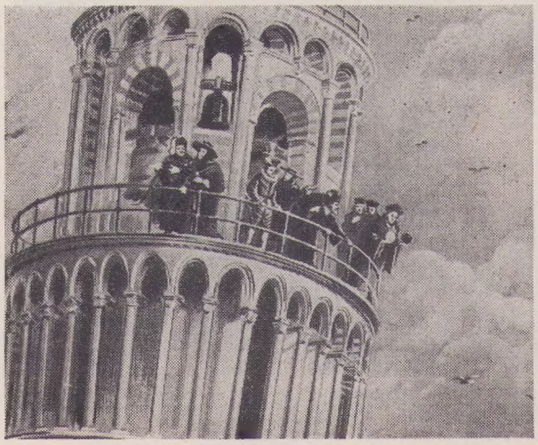
It may be that newspapers a hundred years from now will still be carrying stories which call for something to be done 'immediately' to save the Leaning Tower from falling over.

* * *

The Leaning Tower of Pisa is falling down – but will it ever actually fall over?

Galileo (below) used the Leaning Tower for his experiments – he dropped weights from it to demonstrate the fall of bodies under the force of gravity.

* * *



A whaling fleet made up of the factory ship and the catchers

WHALING

WHALES have been used by man as a source of meat, bone, and oil since prehistoric times, but the only whales which could be killed were the smaller species which had strayed into shallow water where they could not escape, just like in The Faeroes today. The commercial exploitation of whales began in about 1600 and has continued until the present day.

Until the early 20th century whales were captured from open rowing-boats by hand-thrown harpoons, and killed by lances. This hazardous method of hunting has been immortalised in Melville's *Moby Dick*. The species hunted included the right whales (so-called because they were the 'right' whales to kill) and the sperm whale. Whale oil was extracted, and used for lighting before mineral oil became common in the 19th century. Whale bone was also valuable and used in the manufacture of corsets and stays.

These methods, though primitive, were nevertheless very successful, and by the end of the 19th century the three species of right whale had almost been exterminated. The larger species of southern hemisphere whales were still almost completely unmolested. These included the blue whale (see page 162), fin whale, Sei whale and humpback whale. All of these species are too powerful to be killed from open boats. The second phase of commercial whaling began when a method of killing them was found.

A typical catcher. Note the harpoon gun mounted in the bows

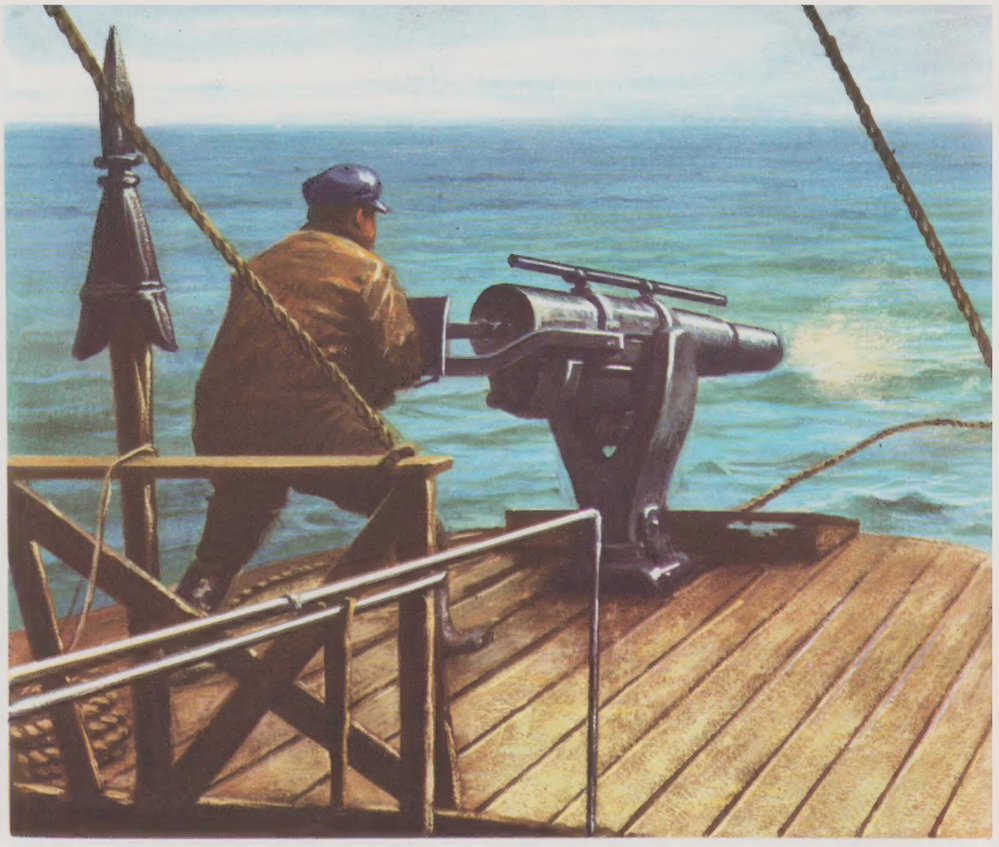
The modern whaling industry

In the 1860's Svend Foyn, a Norwegian, invented a harpoon gun which could be fired from the deck of a larger vessel than an open boat. The range of the harpoon was increased, and, by adding an explosive charge to its head, the whale was killed more easily. It has become the usual practice to mount this gun in the bows of a small steamship. The line from the harpoon is led into blocks in the foremast and thence through a winch into the rope locker. This system works in much the same way as a fishing rod and reel, because the flexibility of the rigging allows the experienced whaler to 'play' a wounded whale until it is exhausted. Usually, however, the whale is killed outright by the explosive harpoon head.

The Norwegians built up a thriving industry in the North Atlantic by using these methods with small trawler-like ships as the 'catchers', catching the fin whales which were at that time common off northern Scotland, The Faeroes, and Iceland. As a result of this, virtually all the crews of modern whale catchers are Norwegians.

In 1904 Captain C. A. Larsen took a small fleet of catchers to South Georgia and began the great period of exploitation of whales in Antarctic waters. At first the factories at which the

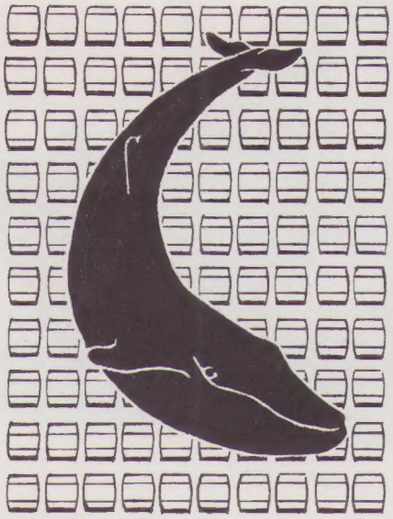
dead whales were stripped of their oil-bearing blubber were all situated on shore. The most important place in the Southern Ocean was always South Georgia, where as many as six companies operated, but there were also shore factories on some of the other Antarctic islands. During the summer months, when the whales frequent these waters, the catchers would put to sea and remain there until they had caught as many whales as they could conveniently tow. After returning to the factory, each whale would be hauled up to the *flensing plane*, upon which it was cut up, and the blubber rendered into oil in great cooking pots known as digesters.



The end of the hunt. A good gunner always tries to get within 50 *yards of the whale*

Ocean whaling

Gradually, because the catchers had to go further afield, they spent more time towing whales than catching them. Thus the next development was to introduce the idea of *pelagic whaling* (that is, open ocean whaling). For this a floating factory ship takes the place of the shore factory. This increases the range of the catchers, because the factory ship can follow behind them and reduce the towing distance.



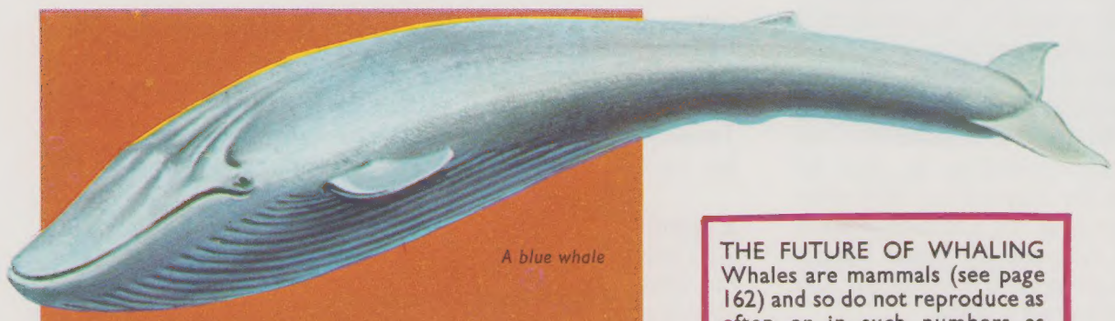
The average yield of a blue whale is 100 *barrels of oil*

The factory ship is specially built with a slipway in the stern so that the whales can be hauled up to the platform by means of winches. The digesters are situated below this deck so that the useful parts of the carcass can be cut up with the minimum delay. The first factory ship began operation in 1925, and soon pelagic whaling became the normal method of working in Antarctic waters. This combination of a factory ship and a fleet of catchers is ruthlessly efficient. Between 1904 and 1939 more than 630,000 whales of different species were killed in Antarctic waters, and more than 390,000 of these were taken by pelagic whalers.

Most of our knowledge about the biology of the southern whalebone whales is based upon the work of the British scientists of Discovery Investigations, who worked in South Georgia and on factory ships between 1925 and 1939. Their research showed that the population of whales was decreasing, and their recommendations led to international control of whaling. Various measures which were adopted included the creation of a protected area in the Pacific sector of the Southern Ocean, complete protection of the humpback whale, and limitation of annual catches. The International Whaling Agreements were observed by all the nations possessing fleets, but, even so, in the 20 years during which the agreements have operated the stock of whales has continued to decline.

On board the factory ship the whale is flensed, and the blubber dropped into the digesters. On the left: a whale being hauled aboard

before firing. Above right: the lookout sees the plume of spray as a whale rises to breathe. Below: the dead whale is marked with the company's flag



A blue whale

THE PRODUCTS OF THE WHALING INDUSTRY

During the whole of the modern era of whaling the principal product has been oil. Whale oil is normally measured by the barrel (equivalent to $\frac{1}{6}$ ton), and a blue whale of average size will yield about 100 barrels. Because of the different sizes of the different species, it has become customary to speak of 'blue whale units' in which it is assumed that the average yield of a blue whale is equal to that from 2 fin, $2\frac{1}{2}$ humpback, or 6 Sei whales. The oil is principally used as a constituent of margarine, and for the manufacture of glycerine used in the chemical industry.

During the early years practically the whole of the remainder of the carcass was regarded as worthless and was dumped in the sea. Gradually, however, it was realised that the meat and bone could be converted into fertilisers. During the period of food rationing just after the Second World War, whale meat was brought to Britain for human consumption.

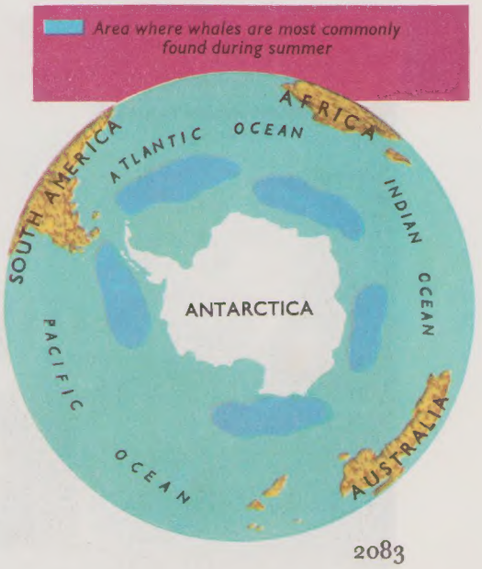
The valuable commodity known as *ambergris*, which has been used for many centuries as a fixative for scent, is not found in any of the whalebone whales. This is only obtained from the sperm whale.

THE FUTURE OF WHALING

Whales are mammals (see page 162) and so do not reproduce as often or in such numbers as do other inhabitants of the sea. Therefore, unless there is a further restriction on this continual slaughter the total population of whales will continue to fall. Because of the difficulty of estimating the total world population of whales of different species, the early limitations upon the annual catch (15,000 blue whale units) was probably not nearly severe enough. Gradually there was a decline in the number and size of whales caught. This was first obvious in the stocks of blue whales, the largest and most profitable to kill, and among the humpback whales, which were the easiest to catch.

During the Second World War the whales were less molested, but between 1945 and 1960 about 500,000 whales were killed. Although the International Whaling Commission has tried hard to restrict the annual catch, and thereby conserve the population, there has been increasing pressure to relax these regulations. The first dangerous step was to allow killing of humpback whales again in 1949, and this was followed in 1955 by the reopening of the protected area of the Pacific Ocean to whalers.

It is difficult to see how the whaling industry can continue much longer. The costs of running a factory ship and fleet of catchers are high, and they cannot put to sea unless a full cargo can be ensured. Perhaps this fact, alone, will mean that these species of whale will survive extermination, but their numbers will fall to a dangerously low level before long.



MENDEL AND HEREDITY

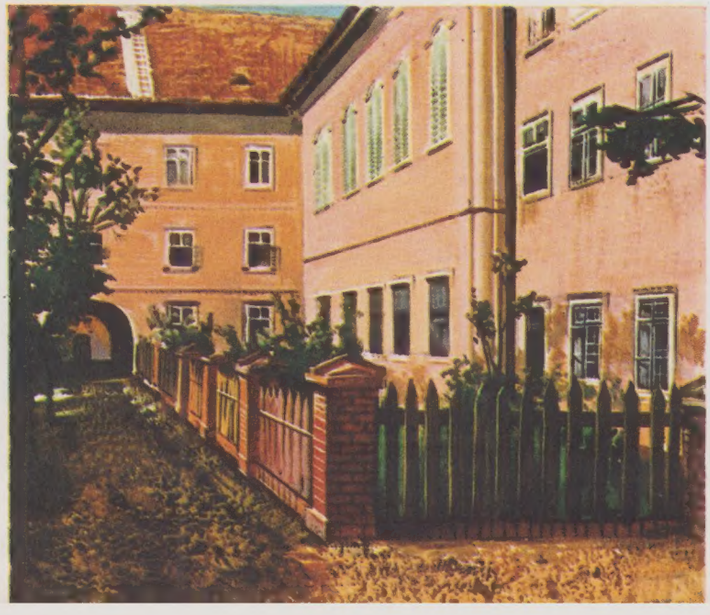
THE Abbot was distinctly plump, but since he was the Abbot of a monastery renowned far and wide for the excellence of its food, a moderate paunch was probably excusable. It was not really surprising that the monks in the monastery of St Thomas fed so well, for the house was an unusually wealthy one. It owned many farms in the country, and next to the monastery buildings lay a large and well-stocked garden. The Abbot delighted in this garden, and during his earlier years as a monk he had spent many hours on summer days working among countless rows of pea plants. To most people it was a mystery why these plants needed so much of the monk's attention; and it was a mystery why the plump, bespectacled monk should gently pull the flowers of so many of the plants into little pieces. But the monk knew what he was doing well enough. For him the mystery lay within the plants, and he, Father Gregor Mendel, intended to reveal it for all mankind to see.

A monk's life

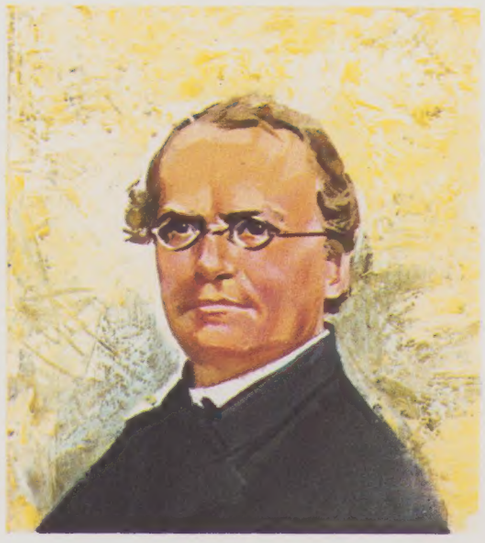
Gregor Johann Mendel was born in the village of Heinzendorf in Moravia in July 1822. His parents were peasant farmers, who, though pitifully poor, realised the advantages of a good education for their only son. Gregor (as a child he was known as Johann) began by attending the school in the village, but soon he moved to the High School about 20 miles away, and later to the Philosophical Institute in the town of Olmütz. Unfortunately the worries and the effort of his studies affected the young man's rather delicate health. He realised that for him a placid way of life was necessary, and so, in 1843, he asked to be admitted as a novice to the Augustinian monastery of St Thomas in Brünn, now known as the Czechoslovakian town of Brno. The tranquillity of monastic life suited Gregor Mendel well. His religious studies progressed favourably, and in 1847, when he was 25, he was ordained a priest.

The Augustinian Order is not a strict one, and many of the monks worked outside the monastery. Mendel became a schoolmaster, and in 1854 he was appointed physics and natural history master at Brünn Modern School, where he taught for 14 years. This was the most important part of his life, for it was during these years that he found time to do his immortal experiments on the pea plants in the monastery garden.

The garden at Brünn where Mendel carried out his experiments



When the Abbot of the monastery died in 1868, the monks elected Gregor Mendel as his successor. For the next 16 years Mendel administered the monastery and its lands, attended to innumerable charities, and went to scientific meetings throughout Europe. As if this were not enough, he became involved in an interminable argument with the government about the amount of tax that the monastery should pay towards the upkeep of the clergy. So heavy were the Abbot's duties that he had little time for work in his garden. But he visited it each day, recording the temperature, measuring the rainfall, and even observing the level of the subsoil water – each day, that is, until 5th January 1884, when Gregor Mendel was found in the morning too ill to leave his bed. The following day he died.



Gregor Johann Mendel (1822–1884)

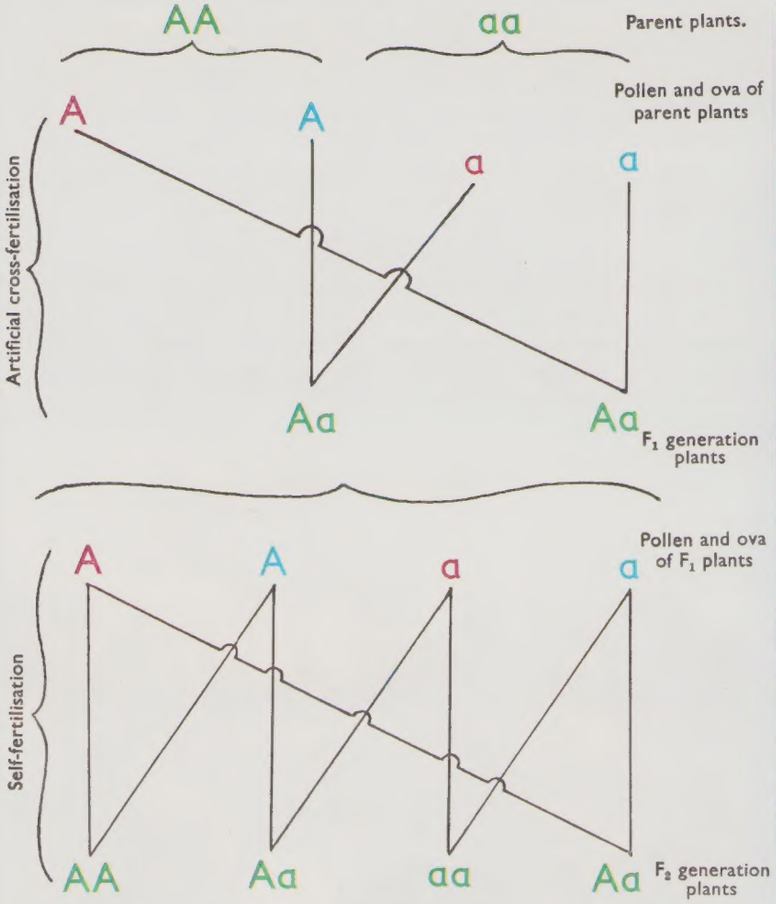
Experiments in a monastery garden

As a scientist, Gregor Mendel's interests were wide. He studied the weather, tried experimental grafts on fruit trees, cross-bred strains of bees, and did thousands of breeding experiments on weeds and on cultivated plants, and particularly on peas.

At the time when Mendel began his work it was known that the pollen grains on the stamens of a flower were the male elements which fertilised the female ova. It was also known that when pollen from one plant was used to fertilise the ova of a variety which had different characters, the seeds which resulted from this fertilisation grew into plants which showed some characters of one parent and some of the other parent. The task which Mendel set himself was that of finding the numerical ratios (proportions) in which the characters of the parent plants were transmitted to their offspring.

From among the many varieties of pea plants in his garden Mendel chose two which he knew always bred true. One was tall, and the other was a dwarf variety. He planted seeds of both kinds, and, when the summer came, he pulled the stamens off the flowers and used the pollen from the tall plants to fertilise the dwarf ones, and the pollen from the dwarf ones to fertilise the tall ones. In this way he artificially cross-fertilised both kinds of plant. When the pods appeared he collected the peas and stored them until the next spring.

In the second year Mendel sowed the pea crop from his cross-fertilised plants. When the new plants grew (nowadays they are called the F_1 generation) there were no dwarf plants at all. Every pea that was sown grew into a plant which was tall. This time Mendel allowed the plants to fertilise themselves, and again he collected and stored the peas.



In this diagram the pea plants are represented by two green letters. The pollen of the plants is represented by single red letters and the ova by single blue letters

THE REASON WHY

Now that you have read the story of Gregor Mendel and his work you may like to know why his experiments gave the results that they did. Mendel, too, was interested in this problem, and although in those days little was known about chromosomes and nothing about genes, he devised a theory which has never been superseded. It is not an easy theory, and for this reason it is illustrated in the diagram on the left.

At the top 'AA' represents the two genes for tallness found in tall pea plants, and similarly 'aa' represents the genes for dwarfness in dwarf plants. These genes exist in pairs in every plant cell, except for the pollen grains and the ova. These carry only single genes, 'A' and 'a'. In cross-fertilisation an ovum with 'A' is fertilised by a pollen grain with 'a' and the resulting seed, a pea, contains a mixture of genes 'Aa'. Ova with 'a' fertilised by pollen grains with 'A' will contain a similar mixture.

When seeds containing the mixture 'Aa' grow into plants the gene 'A' over-rules the gene 'a', and for this reason all the plants of the F_1 generation are tall; 'A' is said to be *dominant* and 'a' is *recessive*. In due course these cross-bred plants produce pollen and ova, and because they contain a mixture of genes some pollen grains and some ova will contain 'A', and some pollen grains and some ova will contain 'a'.

At the bottom of the diagram you can see what happens when the F_1 cross-bred plants fertilise themselves. There are four possibilities. Three of them contain at least one gene 'A', and because this gene is dominant these F_2 plants will all be tall. One possibility contains only the 'a' gene, and these plants will be dwarfs. For every three tall plants in the F_2 generation, one dwarf plant has reappeared!

In the third year Mendel sowed the seeds which he collected from the F_1 plants. As these plants grew (we call them the F_2 generation) a surprising thing was seen. Some dwarf plants reappeared! Indeed, there were 787 tall plants and 277 dwarf plants, a ratio of approximately 3 to 1.

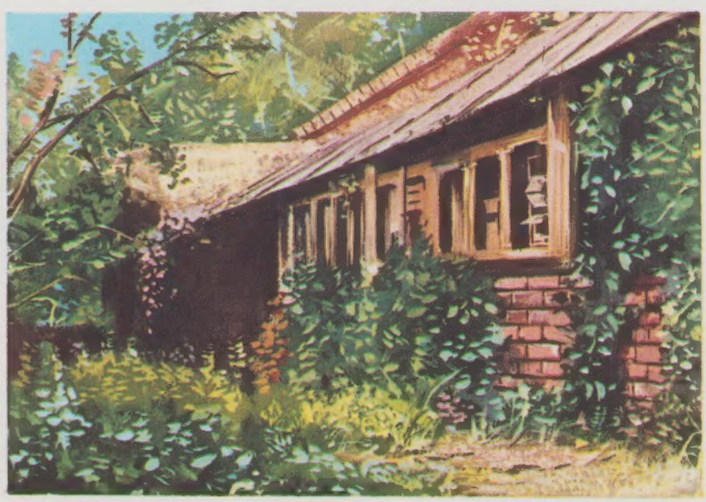
In other experiments Mendel recorded the shape of the pods, the colour and surface of the peas, and the position in which the flowers were attached to the stem. And in every experiment the result he obtained was the same. When varieties with contrasting characters were cross-fertilised, the plants of the F_1 generation showed the character of only one of the parents, but when the seeds of these F_1 generation plants grew the next year, the other characters reappeared in some of the F_2 generation plants. What was even more interesting was that the character missing in the F_1 plants always appeared in approximately a quarter of the F_2 plants. The 3 to 1 ratio was repeated.

Lost and found

Throughout his adult life Gregor Mendel was an active member of the Brünn Society for the Study of Natural History, and it was to this society that he recounted the results of his experiments. In the year 1866 his most important work was printed in the society's journal. But in those days scientific journals did not circulate as rapidly as they do today, and it is sad to record that for more than 30 years the importance of the Abbot's work lay unrecognised. Then, 16 years after his death, three scientists, working quite independently, read Mendel's publication, realised its importance, and mentioned it in their own printed work. Mendel's place in the history of science was assured.

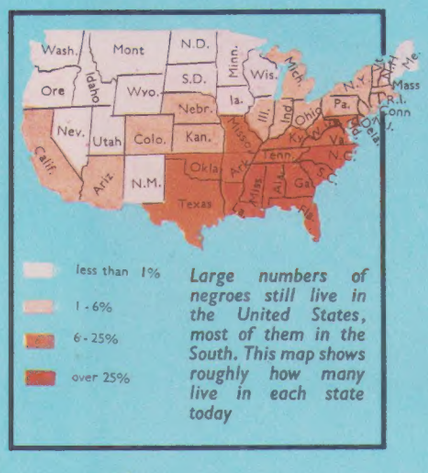
During the 20th century an entirely new branch of biology has grown upon the careful foundations of Mendelism. It is now known that the biological characters of plants are controlled by small segments of the *chromosomes* in their cell nuclei. These segments are called *genes* (pronounced jeans), and the study of genes, or *genetics*, is thus the study of the inheritance of biological characters. It applies to animals, in whom the sexes are usually separate, just as much as it applied to Mendel's pea plants. But time has shown that there are problems and complexities of which Mendel could never have dreamed, and whether or not he realised the vast significance of the discoveries that he made in the monastery garden we shall never know.

Mendel's beehives in the monastery garden at Brünn



SLAVERY IN AMERICA

A young negro slave and her child



Large numbers of negroes still live in the United States, most of them in the South. This map shows roughly how many live in each state today

IN March 1852 a book was published in the United States which was to have an extraordinary influence on thousands of readers, and through them on the future of America. *Uncle Tom's Cabin* by Harriet Beecher Stowe, the wife of an American professor, was one of the most successful novels ever written. Some 300,000 copies were sold in one year, a record for those days. The book became famous all over the United States and Europe, and was translated into more than 20 languages. It was a passionate attack on slavery in America and also an exciting, moving story full of unforgettable characters. It was impossible to ignore the book, which was solidly based on facts, and its terrible picture of slavery in a civilised country.

Uncle Tom's Cabin expressed in story form the feelings and conviction which had been growing steadily in the Northern states of America for many years: that slavery was utterly wrong and unworthy of a great nation which had grown up in a struggle for freedom.

'Somehow this must end,' said Northerners as they cast their votes for Abraham Lincoln in 1860. 'But it cannot end, for that would destroy us,' replied the Southerners as they seceded from (left) the Union and launched the Confederate States of America.

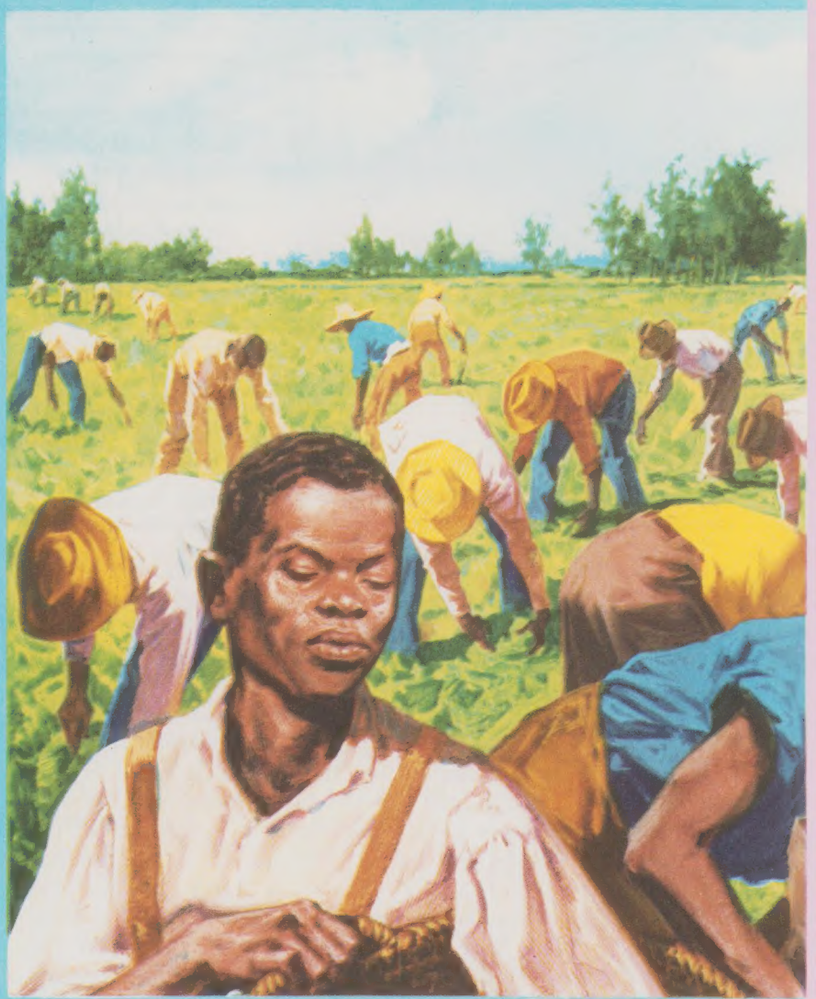
How had such a situation come about?

THE FIRST SLAVES

Slavery in British territories in America began in 1619, when a Dutch ship from the Guinea coast unloaded a cargo of slaves to be sold for working on tobacco plantations. After this, more and more negroes were shipped to the American colonies until by 1776 the United States had nearly half a million slaves. Britons controlled over half the African slave trade, and 192 ships, capable of carrying about 47,000 slaves, sailed from Liverpool, London, and Bristol every year. As the demand grew, traders raided villages in the interior of Africa, and warring tribes even sold their enemies to keep up the supply. The captive victims, tied together by their necks, were driven like animals through the jungle, under the glaring sun for days until they reached the coast. There they were examined by European traders and the young and healthy were branded and herded on to the ships.

CROSSING THE ATLANTIC

The two-month voyage from Africa to America, known as the Middle Passage, was an appalling journey for the Africans, who lived in crowded, insanitary quarters and were chained together. About a quarter of the slaves purchased every year died on the voyage, for fever and disease spread like wildfire.



A group of negro slaves working on a plantation under the strict control

By the middle of the 19th century there were 4 million slaves in America, but of these only 50,000 lived in the Northern states. While Northerners came to disapprove of slavery more and more, Southerners profited from and defended their 'peculiar institution'. Everywhere in the South, in Virginia and North Carolina as well as in Georgia, Mississippi, and Louisiana, slaves were a vital part of the economy, an important source of labour, and a valuable type of property. Most of the slaves belonged to rich planters, and had to work on the cotton and sugar plantations, and in the rice swamps. The invention of the cotton gin, a machine for separating cotton from seed, made cotton the most valuable crop of the deep South, and since its cultivation needed little skill, whole families of negroes were used as labourers, under the direction of overseers.

CONDITIONS AMONG THE SLAVES

Some planter families who had owned land and slaves for several generations were kind people who took pride in looking after their slaves and treating them well. House slaves were especially favoured and were almost treated as part of the family, with plenty of free time. But the Southern aristocrats who looked down on those who ill-used their slaves, were only a small fraction of the whole, and even the best of masters could not protect his slaves from being sold after his death; so that husbands and wives, parents and children were often sent to different parts of the country, never to meet again.

The evidence of plantation records and journals, family papers, account books, letters, and diaries shows that masters often demanded long days of hard work from their slaves, 15 or 16 hours in the fields when crops were being cultivated or harvested. Overseers were often blamed for driving the slaves too hard, but the planters demanded crop yields which could only be gained by excessively long hours at a pace which sooner or later injured the slaves' health. The whip was the most common instrument of punishment, and was the emblem of authority.

Some owners refrained from violence because the value of a slave was lessened if he were badly injured. But others, masters and overseers, were unmerciful in using their almost unlimited powers. Runaway slaves were hunted down with fierce dogs and shotguns, and brutally punished. Even in cases of murder, a slave's word carried no weight against a white man's. Each generation of slaves imported from Africa was made to feel inferior because of their colour, and utterly dependent on their all-powerful masters.

Negroes worked as house slaves for wealthy Southerners

of an overseer. In the background is the home of their owner

THE END OF THE STORY

Such were conditions of slavery in America in the 1850's, when the question of extending slavery to the new states of the west arose, leading to the question of whether the United States could remain half-slave and half-free, and finally in 1861 to the American Civil War (see page 1207). The war did not end until April 1865, but Lincoln had already, in 1862, issued a preliminary proclamation of his intentions. In December 1865 a constitutional amendment abolished and prohibited slavery for ever throughout the United States. So slavery in America was ended, less than 100 years ago – little more than three generations. But before we condemn the Americans, perhaps we should recall that slavery in many of the British colonies continued until 1833, when it was only abolished in the teeth of violent opposition. And of the other 'civilised' European countries, France, Portugal, and Holland were even later than the British in extending human rights to their empires.

Crossing the Atlantic under fearful conditions; many slaves died on this journey

THE MICROSCOPE

IT is certain that the microscope was invented by a Dutchman, but if you were to ask which Dutchman, and in what year he performed this feat, the answer that you would get is much less sure. Perhaps it was Zacharias Janssen or his son Hans, who were spectacle makers in the town of Middleburg; or maybe it was Lippershey, who ground and polished such beautiful lenses in his little workshop. Whoever it was, it is possible that the same person also invented the telescope. Indeed, the discovery of the telescope may have led to the use of a similar instrument as a microscope. So confused, however, are our records of the first telescopes and microscopes that we may possibly never know their true stories. It is enough to say that both instruments were invented in Holland, probably between the years 1590 and 1610.

Inventions as useful as these were not to be ignored, and by 1610 the Italian physicist Galileo Galilei was making both telescopes and microscopes of his own. The lens system that he used differed from that of the Dutch inventors, and, although it worked well in Galileo's telescopes, his microscopes were rather cumbersome. Nonetheless he was able to see with them, and later he wrote to a friend: *The flea is horrible, but the mosquito and the moth are both beautiful.*

Microscopes that were much easier to use were made a little later by the secretary of the Royal Society, Robert Hooke. Finding it almost impossible to grind and polish lenses well enough to give a really clear view at high magnification, Hooke employed globules of glass made by melting pieces of glass rod in a flame. These lenses worked so well that Hooke's microscope was more convenient than any that had been made before.

Now the microscopes which the Dutchmen invented, and which Hooke used, all consisted of tubes with convex lenses (see pages 560 and 570) at each end. Instruments arranged in this way, so that one lens magnifies an image formed by another, are called *compound microscopes*.

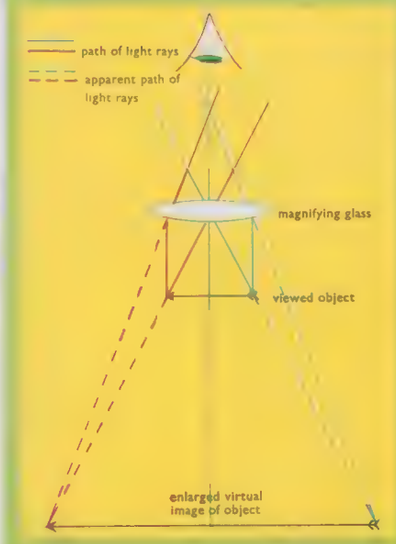
Unfortunately the difficulties of making lenses accurately enough for these compound instruments severely limited the view that could be obtained with them. When another Dutchman, Anthony van Leeuwenhoek, discovered a way of grinding very small but very accurate lenses of high power, he was able to see much more with a single lens, or *simple microscope*, than observers who used the compound instrument. Indeed, by means of his simple microscopes van Leeuwenhoek was the first man ever to see those tiny living forms, the bacteria. Such a situation, however, did not last for long. Ways were found of grinding and polishing lenses for compound instruments, and soon the simple microscope was reduced to the category of 'magnifying glass', as it is known today.

Improvements in the compound microscope followed one another in rapid succession. Probably the most important was the invention of compound lenses. These lenses are made of two types of glass in order to eliminate *chromatic aberration*, the colour fringes seen around objects at high magnification. Another advance was the *substage condenser* of Ernst Abbe. This lens system concentrates light on the viewed object and so makes it appear bright and sharp. These advances in lens design meant that microscopes could magnify objects about 1,000 times. This, however, was the limit, for the ability of a microscope to distinguish between points which are hardly separable, its *resolving power*, is dependent on the wavelength of light. Using white light, the resolving power is about 1/4000th of a millimetre, and this is the optical microscope's maximum capacity.

Robert Hooke's microscope

THE MAGNIFYING GLASS

If you look at a postage stamp held at arm's length, you will have difficulty in seeing the fine details. By moving the stamp towards your eyes, however, the details become clearer and clearer, until at about 10 inches away almost everything is easily visible. If you then try to see even better by moving the stamp to 5 inches from your eyes, you will find that your intention is frustrated. This is because the lenses of your eyes



are not capable of focusing sharp images of anything held nearer than about 10 inches on your retinae.

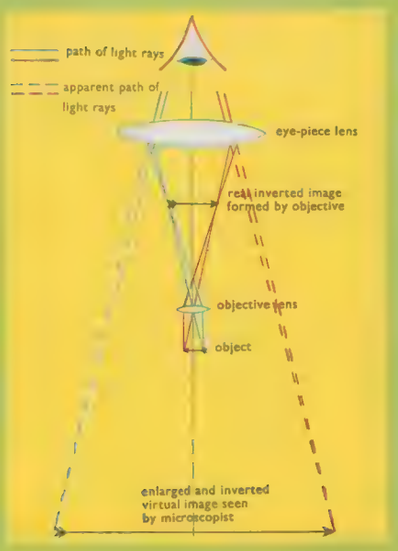
If, however, you take a magnifying glass and place it between the stamp and your eyes, the details on the stamp appear larger and clearer than ever before.

The reason why the magnifying glass enables you to see the fine details is quite simple. Rays of light leaving the stamp reach the lens and, passing through it, are bent in the manner shown in the diagram. On reaching the eyes these rays appear to come, not from the stamp but from a *virtual image* of the stamp. This virtual image is much larger than the stamp actually is, and as it is more than 10 inches away from the eyes, it can be focused on the retinae perfectly clearly.

THE COMPOUND MICROSCOPE

Mechanical and technical improvements have made the appearance of the modern compound microscope very different from that of early instruments. However, in spite of all the modifications, the basic principle of the compound instrument has not changed since it was first discovered.

In modern instruments the length of the microscope tube is usually standardised at 160 millimetres. At the tube's lower end is the *objective*, a powerful and complicated system of lenses which collects light rays from the viewed object and


path of light rays
apparent path of light rays
eye-piece lens
real inverted image formed by objective
objective lens
object
enlarged and inverted virtual image seen by microscopist

focuses them so that a *real image* of the object is formed inside the tube. Usually three or four objective lens systems of different magnifying power are supplied. They are fitted on a *revolving nose-piece* and so can be changed very rapidly. Microscopists use the lower powers when they wish to see a large field, and it is only when the finest detail is to be studied that the highest powered lens is needed.

At the upper end of the tube is the *ocular*, or eye-piece. This is quite a simple lens system. Its purpose is to collect the rays of light from the real image within the tube, and to bend them in such a way that they appear to be coming from a much larger *virtual image*. This virtual image is at the level of the base of the instrument. The diagram shows the way in which this is achieved. Several eye-pieces of different magnifying powers are usually provided. They merely slip in and out of the upper

THE BINOCULAR MICROSCOPE

end of the microscope tube. Like the instrument shown in the illustration, many microscopes have not one but two eye-pieces. Instruments of this type are called *binocular microscopes*, and many people find them less tiring to use than monocular patterns. In binocular microscopes the rays of light from the objective are split into two beams by a prism fitted on the top of the microscope tube. Each beam then forms a separate real image – one for each ocular.

Because modern microscopes magnify up to 1,000 times it is very important for the viewed objects to be properly prepared. Frequently they are thin slices, or *sections*, of tissue mounted on glass slides. The slide is placed on the *stage* of the microscope where it can be moved backwards and forwards and from side to side by small knobs. In this way the whole of the preparation can be viewed.

Focusing is achieved by adjusting the distance between the slide and the objective. In the microscope in the picture this is done by moving the stage up and down by means of the two knobs in the base. In other microscopes the tube is moved.

MADAGASCAR

THE Republic of Madagascar is the fourth biggest non-continental island, after Greenland, New Guinea, and Borneo. It has an area of 227,760 square miles. Situated in the Indian Ocean, it is only 240 miles from Africa. Madagascar was originally joined to Africa and India. It became separated from Africa 200 million years ago, but the link with India was maintained longer, and some of the fauna has Indian characteristics.

Position of Madagascar

THE LANDSCAPE

The principal relief feature of Madagascar is the plateau, criss-crossed by rivers, which stands about 3,000 feet above sea-level. Mountain massifs rise above this general surface near the eastern edge of the plateau. The highest point is Tsaratanana (9,450 feet), in the north.

The east-coast plain is very narrow and fringed with lagoons. The west-coast plain is wider, and consists of a series of plains separated from one another by low hills. The rivers flowing to the west are much longer than those flowing to the east, and many have developed deltas at their mouths.

CLIMATE

The climate of Madagascar is warm, although cooler in the mountains than in the plains. In the hot season, from November to March, the temperature varies from 65° to 84°F, and in the cool season, from April to October, from 62° to 79°F. The capital, Tananarive, is one of the coolest places in the island with a cool-season average of 62° and a warm-season average of 70°F. Seasonal variations are not very great.

As far as rainfall is concerned, there are three distinct regions. The east coast has rain all the year round, brought by the east to north-east winds. Annual totals are often over 100 inches, and in a few places exceed 150 inches. Away from the east coast the climate is much drier; rainfall is generally less than 50 inches, and only about 30 inches on the west coast. In the extreme south-west the climate is really dry, and at Tuléar, for example, the annual rainfall is only 17 inches.

A general view of the high plateau, much of which is now bare of trees

A lemur carrying its young on its back

A Periophthalmus resting on a rock

VEGETATION AND SOIL

At one time most of Madagascar was densely wooded, but now only 13 per cent of the country is classified as forest. The destruction of the woodland was to some extent brought about by the practice of shifting cultivation. For hundreds of years, small patches of forest were cut and burned. The ashes fertilised the soil, and for a few seasons good crops were obtained. But the soil quickly became exhausted, and fresh attacks were made on the surrounding forest.

The tall trees were at first replaced by a mixture of brushwood and shrubs known as *savoka*. This in its turn was burned to provide cattle pasture. Annual burning to encourage the growth of young grass has resulted in a grassland, with a few fire-resistant trees such as the baobab. Cutting and burning have exposed the bare soil to the torrential rains, which have torn great ravines in the hillsides and swept the soil into the valleys.

Forest with trees 70 or 80 feet high is now almost confined to the higher areas of the east. The arid south-west has a semi-desert vegetation, mainly of spiny leafless plants and cacti.

The most common soil is *laterite*, which develops under tropical conditions of abundant rainfall. It is a red-coloured, infertile clay. The coastal soils tend to be sandy. Fertile soils are found in many of the valleys, in parts of the western plains, and in patches in the highlands.

THE ECONOMY

Madagascar is mainly an agricultural country. A great variety of crops are grown in the east, including sugar cane, cocoa, coffee, coconut, vanilla, pepper, and rice. In the drier west, manioc, maize, peas, and cotton are important, and rice is grown in paddy fields in the valleys. In higher central areas, where it is cooler, European crops such as grapes, apples, peaches, mulberries, flax, and beans are grown.

Stock raising is widespread, and the 6 million cattle outnumber the human population. These cattle are of the zebu type, and are such poor milkers that Madagascar imports condensed milk. Many of the cattle live in a half wild state, and therefore suffer from lack of food in the dry season. There are 450,000 pigs. They are not found in coastal areas, where the people are mostly Muslims, who may not eat pork. Graphite and mica are the most important of the minerals. Amethysts and beryls are found in some of the granites, and a little gold is also found. Copper, zinc, asbestos, lead, and lignite are known to exist. Coal is found in the Sakoa basin. Madagascar is also rich in radio-active minerals.

Lack of fuel and bad communications account for the poor development of industry. Food processing is the principal industry. Fruit and vegetables are preserved and sugar refined; soap, cigarettes, perfume, and chocolates are manufactured.

Tananarive: The palace built by Queen Ranavalona I which dominates the higher part of the city

THE CITIES

The capital city, Tananarive, is situated in the centre of Madagascar on a ridge over 400 feet above sea level. The old part of the town is crowned with the palace built by Queen Ranavalona I about 1840, which is now a museum. The city has a population of 206,000. The other towns are really quite small, because the country's economy is not well developed. Majunga, the second largest town, and Tamatave, the most important port, both have only about 50,000 inhabitants, and the next largest town, Diego Suarez, only 27,000.

FACTS AND FIGURES

Form of government	Republic
Greatest length	975 miles
Greatest width	360 miles
Area	227,602 square miles
Population	5,486,713
Capital	Tananarive
Chief port	Tamatave
Official language	French
Railways	537 miles
Motor-roads	19,729 miles

FLORA AND FAUNA

The flora of Madagascar is very varied, and many species of plants are found only in this island. One of the most striking plants is the traveller's tree (*Ravenala Madagascariensis*). This has an enormous fan of leaves at the top of a tall trunk, and the sheaths of the leaf stalks supply pure, cool water. Ebony, rosewood, and sandal trees are to be found in the forest, and there are many creepers and lianas. Some of the creepers, such as the Cryptostegia species, are covered with purple flowers. Orchids are common, and there are over 300 species of ferns. In the lagoons grow arum lilies 12 feet high.

There are no large mammals in Madagascar, but the island is most famous for its lemurs. These are the lowest in the order of primates, and are more plentiful here than elsewhere. No fewer than 25 species of bats have been recorded. There are also boa constrictors, crocodiles, lizards, chameleons, and tortoises. Many of the fishes are brilliantly coloured, and a very curious one found here is the Periophthalmus, or mud-skipper, which from time to time emerges from the water, supporting itself on its fins.

IMPORTS

Textiles, machinery, petrol, cars, iron, and steel.

EXPORTS

Coffee, oils, vanilla, meat, tobacco, graphite, and vegetables.

THE PEOPLE

The population of Madagascar is racially mixed. The original inhabitants were negroes, but their precise origin is a matter of dispute. Indonesians and Malayans have migrated from time to time across the Indian Ocean, aided by the winds and currents. Later the Arabs came and settled mainly along the south-east coast and in the north-west. They in turn introduced African negro slaves. Since the 17th century European blood has been added as well. Both Indians and Chinese live in the east-coast towns.

Two Malagasy

WILLIAM HOGARTH

The Graham Children
(oil; 1742. Tate Gallery, London)

WILLIAM HOGARTH was born in London on 10th November 1697. His father was a schoolmaster, who had come to the city from Westmorland to seek his fortune.

William seems to have shown an early interest in drawing, and in observing life around him. He himself said: 'Shows of all sorts gave me uncommon pleasure when an infant, and mimicry, common to all children, was remarkable in me . . . My exercises when at school were more remarkable for the ornaments which adorned them than for the exercise itself.'

This talent made it natural for him to be apprenticed to a silverplate engraver, and by 1720 he was in a position to start up his own business as an engraver. Among his early works were satirical prints on topical subjects ridiculing the social evils of his day.

At this time his great ambition was to become an engraver on copper, and this needed more skill at drawing than he possessed. But he was determined to master this, and to learn how to paint in oils, and he attended an art school recently opened by Sir James Thornhill, whose daughter he married in 1729, against her father's wishes.

Hogarth believed that an academic training was essential for a young artist, but he showed an even greater interest in carefully observing the various aspects of life around him, rather than merely relying on studio formulae. He said that he felt '. . . that he who could by any means acquire and retain in his memory, perfect ideas of the subjects he meant to draw, would have as clear a knowledge of the figure as a man who can write freely hath of the 24 letters of the alphabet and their infinite combinations (each of these being composed of lines), and would consequently be an accurate designer . . . I therefore endeavoured to habituate myself to the exercise of a sort of technical memory, and by repeating in my own mind the parts of which objects were composed, I could by degrees combine and put them down with my pencil'.

At this time, wealthy men in England prided themselves on their appreciation of art, but they were interested in buying works of the old Italian masters rather than of their own countrymen and contemporaries. The most prominent artists in England after the Reformation were Holbein and then Van Dyck – both foreign painters brought to this country from the continent of Europe.

The Puritan tradition in England resulted in the suppression of extravagant and frivolous compositions, so that only portraiture flourished as a popular form of art.

This conservative attitude was challenged by Hogarth and, a generation later, by Reynolds and Gainsborough. Hogarth's most outstanding contribution to the art of his time was to give a moral attitude to familiar scenes of contemporary life. Crowded with detail, these scenes told a story in picture language, and their implication could be understood easily and appreciated by everyone. Engravings were made from the original oil paintings, and these reached a wide audience – bringing Hogarth fame and money.

The Shrimp Girl
(oil; date unknown. National Gallery)

Hogarth's aims are best expressed in his own words: 'I . . . turned my thoughts to a still more novel mode, viz painting and engraving modern moral subjects, a field not broken up in any country or any age . . . I therefore wished to compose pictures on canvas, similar to representations on the stage; a farther hope, that they will be tried by the same test, and criticised by the same criterion . . . I have endeavoured to treat my subjects as a dramatic writer; my picture is my stage, and men and women my players, who by means of certain actions and gestures, are to exhibit a *dumb show*.'

Conversation pieces

Hogarth's early works were small paintings, some 12 or 15 inches high. Known as *conversation pieces*, they showed a number of sitters informally grouped together. These pictures proved very popular, and Hogarth enjoyed the patronage of such well-known families as the Montagus and Cholmondeleys. The scenes are lively and imaginative, with a real freshness of colour.

Among these works is *A scene from the Beggar's Opera*, painted in 1728, when the play was produced with great success in the theatre at Lincoln's Inn Fields. This picture shows us not only a dramatic point in the play but also the obvious enjoyment of the audience. In another version of the same scene Hogarth included amongst the spectators the Duke of Bolton, who later brought the production to an end by eloping with the heroine – these topical references, needless to say, scoring a great success in London society.

Satirical engravings

By the early 1730s Hogarth was tiring of these conversation pieces, which thereafter appeared only at infrequent intervals, and then probably to oblige the artist's friends.

In 1731 Hogarth painted the first of his moral satires – *The Harlot's Progress*, in six scenes. The original paintings are lost, but engravings made from them proved very popular. The scenes show the

downfall of a young girl in London, and the introduction of famous living characters into these paintings added greatly to their interest. The prints were consequently bought in great numbers and were the beginning of Hogarth's financial success. The fine drawing of this series also brought Hogarth his father-in-law's approval, and for a time he lived with Sir James in Covent Garden.

The story was made into a pantomime and a ballad opera, fans and cups and saucers were decorated with scenes from it, and poems and pamphlets were written on the subject. One aspect of the enormous success irritated Hogarth considerably; a number of pirated copies were printed, without his permission, and these brought him no profit.

In 1733 Hogarth moved into the Golden Head in Leicester Fields, where he lived until his death. By December he had already started on a second 'Progress' series, *A Rake's Progress* (a rake was a fashionable young man who lived a bad life). There are eight scenes in this series.

In the early scenes the young man is shown inheriting his wealth and being introduced into rich society life. In the tavern scene we find the rake in a drunken stupor, sprawling in a chair and surrounded by some women who egg him on. This is the beginning of the rake's decline. He marries an elderly one-eyed heiress and steadily deteriorates, gambling away his money and ending his days in prison. The last picture shows a horrific scene in Bedlam (a well-known lunatic asylum of the day) where the rake dies, a raving madman, surrounded by other wretched and pathetic lunatics.

In such paintings as these every figure and detail plays a part, to add more evidence to the meaning of the scene. They are, as Hogarth said, a 'dumb show'. Often the canvas seems crowded, yet the whole is carefully composed – for the artist had not rejected completely the classical traditions of art.

A Rake's Progress was dated 25th June 1735. Hogarth had held up their publication until an Act of Parliament had been passed which gave him the copyright; his fury at the pirating of earlier prints had made him instrumental in getting this act passed.

The moral attitude in these two progresses is very clear. The consequences for those who lead a bad life are vividly illustrated and they could easily be understood. Henry Fielding, the 18th-century novelist, wrote that the scenes from the *Rake's Progress* 'are calculated more to serve the cause of virtue and for the Preservation of Mankind, than all the Folio of Morality which have ever been written; and a sober Family should no more be without them than the Whole Duty of Man in their House'.

Marriage à la Mode, *Scene II, Early in the Morning*
(engraving after an oil painting, National Gallery, London, 1743)

Hogarth's portraits

The greater part of Hogarth's oil paintings were in fact portraits, and he took this aspect of his work more seriously than his engravings. All his portraits are characterised by their strong sense of realism. This is very apparent in the six unusual studies, *Hogarth's Servants* (National Gallery, London). The concentration on different types of faces was a break from the tradition of fashionable portraiture, where normally only rich patrons were recorded for posterity. Hogarth was much inspired by the work of Van Dyck, and later by Rembrandt (see page 1446), whose brush-work he studied carefully.

Among Hogarth's most popular works is the delightful portrait of *The Graham Children* painted in 1742 and now hanging in the Tate Gallery in London. The children, though posing for their picture, are lively and animated, especially the little boy with the musical box on his knee. Additional touches such as the birds in the cage watched by a cat are typical of Hogarth's keen eye for detail, and help make the scene really live. The freshness

The Election, *Chairing the Member* (from the *Election* series; Sir John Soane's Museum, London)

The Idle 'prentice, from Industry and Idleness

of his technique is equally apparent in *The Shrimp Girl* (in the National Gallery, London), with its harmonious colouring that often surpassed that of Gainsborough and Reynolds.

An outstanding success was his portrait of the famous actor David Garrick as Shakespeare's Richard III, painted in 1746. He was paid £200 for this; 'more', he said, 'than any English artist ever received for a single portrait'.

'Marriage à la Mode'

The engravings of *Marriage à la Mode* (1743–1745) depict in six scenes the sad consequences of a marriage arranged for social and financial reasons only, and not for love. The story is not a particularly original one, but Hogarth's perception made it forceful and entertaining. The *Early Morning* scene illustrates the kind of useless life led by a wealthy Earl who is lounging in a chair exhausted by his all-night revels. The architecture of the room, the fireplace, and the ornaments tell us exactly how a Georgian drawing-room of the wealthy looked in those days. Hogarth has left us a remarkably faithful record of the life he saw around him.

The prints of *Marriage à la Mode* were too costly to have a wide appeal, and from 1745 to 1751 Hogarth concentrated mainly on boldly drawn, cheaper prints with an obvious moral, designed to interest 'men of the lowest rank'. Among these was the series published in 1747, known as *Industry and Idleness*. This consists of 12 pictures showing the careers of two apprentices, one industrious (hard-working) and one idle. The two scenes illustrated here show the reward for virtue and the punishment for vice. What could be a more just reward for the industrious apprentice, who used his talents well, than to become Lord Mayor of London? And what could be more fitting than the miserable end of the idle apprentice? Again the theme was an ordinary one, but it was transformed by Hogarth into a powerful pictorial image that became extremely popular.

The Industrious 'prentice, from Industry and Idleness

Hogarth's later works

Among the later successful prints was the *Election* series of 1755–1758, said to have been inspired by the rather doubtful election methods used in Oxfordshire that year. These engravings are heavily satirical and designed to provoke Parliamentary reform. There are an amazing number of little scenes within each picture that demand close observation, and this series is among the most elaborate of Hogarth's works.

An Election Entertainment illustrates the voters being entertained on a lavish scale in some country inn. *The Canvassing for Votes* tells us of the appalling bribery that went on, each Party competing wildly for votes. In the third scene the search for support becomes even more frenzied, and 'reserve' voters are called in – the blind, the idiots, the maimed, even a half-dead man from hospital – anyone who can tip the balance with his vote. The final scene shows the *Chairing of the Member*, with the triumphant member being hoisted above the crowd and pandemonium breaking out in every direction.

In spite of his success in the field of portraiture and satirical engravings, Hogarth made a number of attempts to establish history painting in the Grand Manner in England. But patrons continued to import works from abroad.

Hogarth died in October 1764. His place in the history of painting is rather isolated, for his art was too personal for him to have many followers. But the vigour and drama of his work, especially his social satires, gave a new life and point to English painting.

INFLUENCE OF PLANTS ON THE LANDSCAPE

THE vegetation of different parts of the earth is closely linked with geology and soils. Some plants only grow well in certain soils, the mineral content of which often depends on the underlying geology. But soil type may also depend on the vegetation – for example, a *podzol* forms under a coniferous forest, but not under grassland. The type of vegetation is also dependent on climate. These various factors are interdependent, and the situation is a very complicated one. Vegetation modifies landscape in two main ways: it acts as a protector of the soil underneath, and under certain conditions is capable of building up new land.

A forest-covered hillside. Here the underlying soil is properly protected against the elements

The erosion of a neighbouring hill from which the forest cover had been cut down

Vegetation as a protector

The roots of shrubs, bushes, and grass bind the soil together, and the branches and leaves help to break the force of falling rain. Decaying matter underneath the plants gives further protection to the soil. We only become aware of this when something is done to upset the balance that nature has established. Man, by cutting down forests or by burning them, or by allowing his herds to overgraze pasture-land, can set off a train of events which will completely alter the landscape. In forested areas, where slopes are steep and rainfall heavy, soil is often rapidly swept down the hillsides once the protective cover is removed. Gullies quickly appear which are rapidly deepened into great ravines. Consequently one hill may remain resplendent under its forest cover, while a neighbouring one may be a bare wilderness, the colour of the sub-soil often giving it a garish appearance, sometimes a bright yellow or even red.

In areas which are overgrazed the deterioration is not so rapid, but nevertheless serious. Most grasslands consist of a mixture of annual and perennial species. Overgrazing results in the death of some perennial plants which tend to be replaced by annual ones, which reproduce more effectively. As overgrazing continues, the proportion of annuals becomes higher and higher. As natural grasslands usually occur in rather dry areas, bare patches begin to appear in the summer. On flat land strong winds tend to blow the soil away in great dust-storms since it lacks the roots of perennials to hold it together; where it is hilly the first heavy rains tear away the unprotected soil. In this way grasslands have been converted into deserts, and sand dunes drift over barren wastes where once cattle grazed. Some areas have been destroyed past recall. Many a bare rocky slope along the Mediterranean once supported a dense forest, and farms have disappeared from eroded lands in the United States.

Much can be done to repair areas where damage has not gone too far. Success depends on the possibility of providing a protective vegetation cover once more. Flat grasslands require the removal of stock and the seeding of perennial species. Slopes often need terracing before they are planted with trees to check the downhill wash of soil by rain. The slopes of gullies are held together by the use of special plants which grow quickly and bind the soil together.

Vegetation as a landscape builder

Vegetation is able to build up land which was previously under water. The most common way in which this is accomplished is by the growth of plants in lakes and other small water-filled hollows, particularly those without an outlet, or through which the flow is very sluggish. Decaying vegetation, mainly reeds, rushes, mosses, irises, and water plants, forms a thick layer of vegetable matter, the decomposition of which is slow because of the lack of air. Consequently it accumulates more rapidly than it decays. In time the edges of the lake become bog or marsh, and eventually the entire body of water may disappear. This has been a common process in parts of Ireland.

A similar process takes place in sheltered muddy or sandy estuaries along the coast, when salt marshes are formed. In such places a definite succession of plants occurs. The first colonies consist of those which can survive conditions of salinity and daily flooding. The *marine algae* are usually first on the scene, followed by such plants as the *Zostera* species, the eel grasses, which flourish despite frequent submergence. Later grasses, such as the *Puccinellia* or *Spartina* species, continue to build up the level by trapping sand and mud and adding their own decaying vegetation to the accumulated material. When the marsh has reached the point where the highest tides can only just reach it, plants such as the *Juncus maritimus* become dominant. In time the salt marsh may become a fresh-water swamp, which in turn may be colonised by bushes and trees.

Here the margins of a lake have been converted into swamp by the growth of vegetation

SAINT PAUL

ST PAUL was one of the first great Christian missionaries, and none have been more heroic than he was. 'Five times the Jews have given me the 39 strokes; three times I have been beaten with rods; once I was stoned; three times I have been shipwrecked, and for 24 hours I was adrift on the open sea. I have been constantly on the road; I have met dangers from rivers, dangers from robbers, dangers from my fellow-countrymen, dangers from foreigners, dangers in towns, dangers in the country, dangers at sea, dangers from false friends. I have toiled and drudged, I have often gone without sleep; hungry and thirsty I have often gone fasting; and I have suffered from cold and exposure.

'Apart from these external things, there is the responsibility that weighs on me every day, my anxious concern for all our congregations. If anyone is weak, do I not share his weakness? If anyone is made to stumble, does my heart not blaze with indignation? . . . The God and Father of the Lord Jesus (blessed be His Name for ever!) knows that what I say is true' (*II Corinthians* 11: 24–31).

His conversion

The story of his life is told at length in the Acts of the Apostles, and we can learn a lot from his letters, the *Epistles*, which he wrote to the early Christian communities, and to individual friends, in the course of his missionary work. It is an astonishing story. His original name was Saul, and when he was young he was deeply instructed in the traditional faith of the Jews, to which he was fervently devoted. At first the new faith of the Christians seemed to him a challenge and a menace. He witnessed the stoning of St Stephen, and reflected on how most effectively to meet this new challenge. Perhaps in the process he came to understand it better. But he was still bent on persecuting the Christians, and with this in mind he applied to the High Priest 'for letters to the synagogues at Damascus authorising him to arrest anyone he found, men or women, who followed the new way, and bring them to Jerusalem. While he was still on the road and nearing Damascus, suddenly a light flashed from the sky all around him. He fell to the ground and heard a voice saying: "Saul, Saul, why do you persecute me?" "Tell me, Lord," he said, "who you are." The voice answered: "I am Jesus, whom you are persecuting" ' (*Acts* 9: 2–5).

The voice told him to go to Damascus, where he would be told what else he should do. Saul was blinded; but he went on to Damascus, and three days later his sight was restored to him, and he was baptised.

This is the story told by the author of the *Acts*, and in two of his letters St Paul himself told how he had been converted by a vision of the risen Jesus. To the *Galatians* he wrote: 'You have heard what my manner of life was when I was still a practising Jew: how savagely I persecuted the church of God, and tried to destroy it; and how in the practice of our national religion I was outstripping many

A reproduction of an early picture of St Paul

Quotations in this article have been taken from the New English Bible.

of my Jewish contemporaries in my boundless devotion to the traditions of my ancestors. But then in His good pleasure God, who had set me apart from birth and called me through His grace, chose to reveal His Son to me and through me, in order that I might proclaim Him among the Gentiles' (*Galatians* 1: 13–16).

The Apostle of the Gentiles

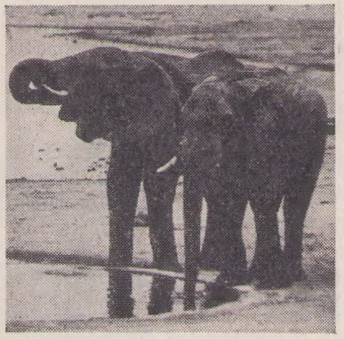
It soon became known that the persecutor of the Christians had himself become a Christian, had changed his name to Paul, and had become as fervent a Christian as he had been a Jew. But it was many years before he started his great missionary journeys among the 'Gentiles', as the non-Jewish peoples of the Roman Empire were called. He came to recognise this as his own special work, the task for which God had called him. The Christians have always claimed that their faith came by the special revelation of God in Jesus; but it is clear that Christianity also owes a tremendous debt to the Jewish faith in which Paul, like all the Apostles, had been brought up. In the early days it was a burning problem how much of Jewish thought and practice should be carried over into the Christian Church. Paul was particularly concerned not to include so much that the Gentiles would feel outsiders. Paul made it clear when he wrote to the Galatians that he knew what he was doing in putting behind him some vital Jewish practices. He was well aware of their worth: for he had been as strict a Jew as any. At the same time, in insisting on changes, he was not influenced by any 'party' in the Church. He maintained that his authority as an Apostle came to him direct from God.

The Gospel

Paul firmly insisted that he was not preaching a new faith. He was the first Apostle of the Gentiles, but he was not the first Apostle to admit Gentile converts. His authority came direct from God, but it was no new Gospel that he preached. The *First Epistle to the Corinthians* is perhaps the most moving of all his letters. It is full of both argument and practical instruction, and deals with many aspects of Christian life. In chapter 11 he describes the nature and meaning of the Lord's Supper (Eucharist). In chapter 13 he gives his famous hymn to Divine Love or Charity. Finally he states clearly and definitely the basis of his faith: 'I must remind you of the gospel that I preached to you . . . I handed on to you the facts which had been imparted to me: that Christ died for our sins, in accordance with the scriptures; that He was buried; that He was raised to life on the third day, according to the scriptures; and that He appeared to Cephas (Peter) and afterwards to the Twelve', and to many others. 'In the end he appeared even to me' (*I Corinthians* 15: 1–8).

In the name of this faith he suffered stripes and shipwreck, and eventually went to stand trial in Rome itself, before the Roman emperor. The *Acts* closes when Paul reached Rome; his last letters were written in prison there. Various stories were told later on about his last years: they differ in detail, but the early legends agree that he died in Rome for his faith. The *Acts* and the *Epistles* tell of many struggles, against the enemies of the Church and against those who disputed with him within the Church. They also let us into the secrets of this deeply human man, who inspired so much opposition, hate, admiration, and love, and who did so much to direct the early growth of the Christian Church.

FAVOURITE ANIMALS COMPETITION – results



KNOWLEDGE READER TO ADOPT BABY ELEPHANT

Toto, London Zoo's baby elephant, has a new foster parent. She is 11-year-old Penny Moon, of 3 Bradford Road, Lewes, Sussex. Penny sent in the winning entry in the special competition for British and Irish readers, set in 'Knowledge News' dated 17th March. Readers were asked to tell us about their favourite animal, its appearance and habits. The entries were judged by Armand Denis, Editor-in-Chief of 'Animals', and the winner will adopt Toto for one year. The winning entry is published below, and a report of Penny's visit to London Zoo to meet Toto will appear in a future issue of 'Knowledge News'. Penny has won the first prize by writing about her favourite animal – a mouse.

The most popular animals among the other entrants were cats of all sizes. Dogs were a close second, followed by horses and ponies. Then came elephants and chimpanzees, giraffes and hamsters, rabbits and koala bears.

THE OTHER PRIZE WINNERS

TWENTY consolation prizes have been awarded to the following entrants. The animals they chose are given in brackets.

A 6-months subscription to 'Animals' has been won by:

Jane Laurie (age 11), Cockeymoor, N. Brewham, Bruton, Somerset. (Donkeys.)

Paul Egan (age 13), 3 Sonning Street, London N.7. (Dogs.)

Alan Aplin (age 10), 3 Brewers Lane, Bridgemary, Gosport, Hampshire. (Chimpanzees.)

Kenneth Owen (age 9), 39 Cambridge Avenue, Solihull, Warwickshire. (Lions.)

Sarah Butterfield (age 9), 3 Maids of Honour Row, Richmond, Surrey. (Dragons. Sarah's entry is published on this page.)

John Lavelli (age 7), 20 Hillside Close, Morden, Surrey. (Hippopotami.)

Jonathan Whitehall (age 9), Todding Cottage, Leintwardine, Craven Arms, Shropshire. (Cats.)

Lindy Lucas (age 7), 71 Ravensdale Avenue, London N.12. (Her hamster.)

Leonie van Agt (age 12), New Park, Stillorgan Road, Blackrock, Co. Dublin, Eire. (Giraffes.)

Marshall Sedgwick (age 10), 20 Spring Crescent, Whittle-le-Woods, Nr. Chorley, Lancashire. (Elephants.)

A copy of Henry Williamson's 'Animal Saga' has been awarded to the following:

Carol Ford (age 8), 28 Holmesdale Road, Highgate, London N.6. (Her dog, Rex.)

Linda Hunter (age 10), 26 Durham Drive, Windyknowe, Bathgate, West Lothian, Scotland. (Shetland ponies.)

Andrew England (age 7), 26 Carlyle Avenue, Blackpool. (Lucy, the llama at Blackpool Pleasure Gardens.)

Malcolm Whitehead (age 7), 8 Bridge Gate, London N.21. (Big cats.)

Susan Thompson (age 11), Brook House, Brook Street, Rearsby, Leicestershire. (Henrietta, her pet hen.)

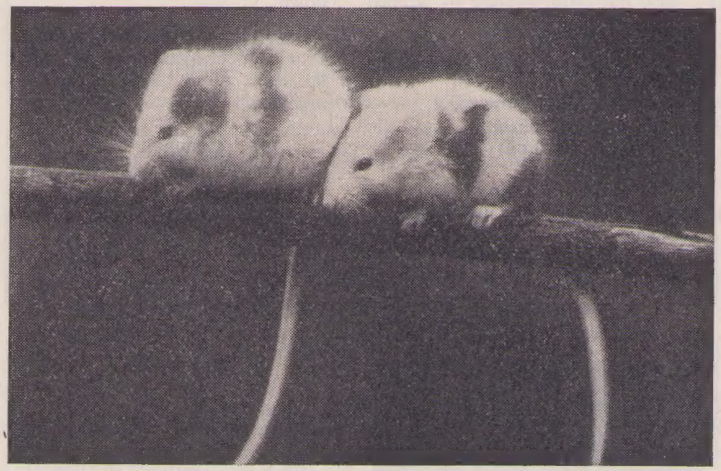
Elizabeth Lee (age 13), 31 Pine Walk, Sarisbury Green, Southampton. (Pythons.)

Dean Sephton (age 8), 2 Links Avenue, Southport, Lancashire. (Elephants.)

Paul Lloyd (age 13), 1 Ilston Place, West Cross, Swansea, Glamorganshire. (Armadillos.)

Susan Brookes (age 11), 10 North Close, Ipswich, Suffolk. (Dolphins.)

Thomas John White (age 10), 16 Oak Park Avenue, Shiphay, Torquay, Devon. (Mongooses.)



THE WINNING ENTRY:

'A LONG pink tail, covered with shining white hairs, droops over the edge of the cage, and a tiny pair of silky hands appears gripping the entrance hole. Two ruby eyes, a twitching nose and twenty quivering whiskers come into view. Can this creature with blood-red eyes smell me? Can he sense me, or is it instinct that tells him I am coming?

'A fat, round body and a scrabbling pair of silvery-toed hind feet are dragged into view. His furry body is stretched towards his tiny plastic bowls of seed and milk-soaked bread. In a flash he is crouched on his bowl edge, balancing on his tail like a kangaroo. His scythe-shaped claws hold a sunflower seed, and he cracks the striped case like a squirrel.

'Once a week his nest, which he has so cleverly woven from torn shreds of wrapping paper like a wasps' nest, is cleaned out. Then he swings up my sleeve and dives into my pocket looking for cake crumbs.

'My favourite animal? I love him so: Johnny Brighteyes, my mouse.'

Penny Moon (age 11),
3 Bradford Road,
Lewes, Sussex.

SARAH LIKES DRAGONS

SARAH BUTTERFIELD, aged 9, of Richmond, Surrey, had a rather unusual choice – an animal that does not exist!

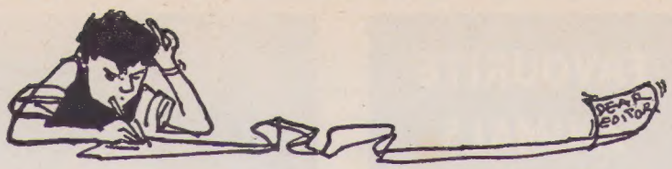
'Dragons are my favourite animals. They have greeny blue scales all over their bodies. Generally a little smoke is coming out of their nostrils when they are happy, but fire comes out when they are angry. Their eyes are red, with short black eyelashes.

'They always wash themselves and sharpen their claws as soon as they wake up. They must sleep in a full-size bed with a few blankets and a sheet or they will die of cold. Always polish their scales every week. Watch-dragons are very good instead of a watch-dog. They can blow out their flames and burn the robbers if there are any. If you have television you will find they like programmes about lizards and aeroplanes.

'If you ever have a dragon you must take him for walks and flying. Every day he must fly eight miles, but when you fly him, make sure no policemen are about or they will make you pay some money for not having a licence.

'I like dragons best of all because they come from the heart of the earth and live to be five thousand years old.'

You write – thousands read!



Loch Ness

DEAR EDITOR—Your article about the Loch Ness Monster in *Knowledge News* interested me. I have a theory about how the monster got into Loch Ness.

Millions of years ago, a lot of monsters lived in the sea. Loch Ness was just a cove, and one of these monsters made its home there. Then the cove was cut off from the sea and became a lake, where the monster continued to live. I think its descendants are still there.

Ian Maclean (*age* 9),
151 *Beeston Hill*,
Leeds 11.

. . . Monster

DEAR EDITOR—I do not agree that the Loch Ness Monster is a plesiosaur that was stranded there. There are numerous other monsters that could have been mistaken for a plesiosaur.

Some plesiosaurs had long, thin necks and short heads; others had long heads and short necks. Instead of legs they had flippers like a turtle, with which they swam slowly through the water. Slowness was no handicap, for their heads could swing 40 feet from side to side to snap at passing fish.

One eye-witness stated that the total length of monster visible was about 15 feet. Plesiosaurs grew up to 50 feet, however.

Michael Davis (*age* 12),
236 *Pelsall Lane*,
Rushall,
Nr. Walsall, Staffordshire.

In the Soup

DEAR EDITOR—The waiter placed a bowl of soup before the customer, then, glancing out of the window, remarked: 'It looks like rain, sir.'

The customer took a spoonful of soup and angrily replied: 'It tastes like it, too!'

Andrew Magarek (*age* 10),
19 *Up Corner Close*,
Chalfont St. Giles,
Buckinghamshire.

Riddle of the Sands

DEAR EDITOR—My family were once waiting for the ferry going across the mouth of the River Dovey when all of a sudden my mother and little brother sank up to their knees in a small patch of quicksand.

There is a Welsh legend still told today about a man who was out on these same sands with a horse and cart. He is believed to have sunk beneath the surface, together with his horse and cart, and was never seen again.

S. H. Bowdler,
Ashleigh,
66 *Finchfield Road West*,
Wolverhampton, Staffs.

Lucky you!—Editor

Chemists' Club

DEAR EDITOR—I am a keen junior chemist, and thought it might be possible to form a club with other *Knowledge* readers. The members could exchange ideas and experiments and perhaps form branches of the club in different towns. Please write to me if you are interested.

David Galligan,
67 *Western Drive*,
Gabalfa, Cardiff.

An African Journey

DEAR EDITOR—The article 'Towns in the Congo' (*Knowledge* No. 117) reminded me of the holiday my family had a few years ago.

We left by train from Durban, to go to Elizabethville. In the dining saloon I was given a 'ginger square'. This is a drink of ginger brandy, ginger ale, a slice of lemon and a cherry. It was delicious, but one was quite enough for me.

When we arrived at the Victoria Falls, on the Zambezi river, we could hear the thunderous roar of the falls even from the station. When we looked up into the sky we could see clouds of 'steam' caused by the spray from the falls. The train crossed the river by a bridge, and I thought I saw a crocodile.

After passing through Ndola, in Northern Rhodesia, we saw some strange sights, including gigantic ant heaps standing about ten feet high.

In Elizabethville we were taken to our hotel, not far from the cross-roads at the centre of the town that is shown in the picture illustrating your article. On the second day there, we went to the zoo and saw leopards, vultures, and eagles, baboons, gorillas, crocodiles, and turtles, and many brightly coloured parrots and other tropical birds.

I now have a miniature elephant made of ivory as a souvenir of this holiday.

Alvin Morty (*age* 16),
28 *School Road*,
Wentworth,
Durban, Natal,
South Africa.

Glacial Deposit

DEAR EDITOR—In your article about East Anglia (*Knowledge* No. 7) you said that Breckland was covered with sand after the Ice Age.

Opposite my home is a sandpit which was also formed after this period. During the Ice Age, a huge glacier moved down to the Midlands from North Wales, bringing with it a considerable amount of sand. When the glacier reached Brewood, it melted, depositing the sand, where it remains today.

John Redman (*age* 13),
The Bungalow,
Horsebrook Lane,
Brewood, Stafford.

Rock Temples

DEAR EDITOR—Near the city of Aurangabad, in Maharashtra State, are the famous Ajanta Caves. They are rock-cut temples, arranged in a horseshoe shape, which used to be monasteries and Buddhist temples. Buddhist travellers from China called this place 'Dakshina.'

The temples were carved between the 2nd and 7th centuries, but they remained concealed for about 1,000 years. In 1819 they were discovered by some British soldiers.

The inner walls of the caves are beautifully decorated with frescoes and sculptures. The painting is still clear and the colours have not faded.

Deepak Merchant (*age* 15),
Sydenham College,
B Road,
Churchgate Reclamation,
Bombay 1, *India.*

Pocket-money Puzzle

DEAR EDITOR—I have invented a puzzle for your readers.

Tom, Dick, and Harry have just been given their pocket money. Harry has twice as much as Tom and Dick put together. If Harry gives Tom 5/-, then Harry will have twice as much as Dick, and Dick will then have 2/- more than Tom. Find out how much money they have each.

The answer is that Tom has 2/6; Dick has 9/6; and Harry has £1/4/0.

Jonathan Stopes-Roe,
155 *Moor Green Lane*,
Moseley,
Birmingham 13.

Can you answer these?

Put the same letter in front of each of the three words in these groups, so that three new words will result:

1. -END; -ALL; -RIDE.
2. -EAR; -OWL; -LAKE.
3. -EAT; -HIP; -TAKE.

Replace the ? with the number which fits the sum:

4. $6\times3=20-?+6$.
5. $(7\times4)-2=(13\times?)-13$.
6. $\frac{24}{4}=\frac{?}{3}$

Change round the first letters of the words in these groups so that three new words will result; do not make any other changes:

7. Sea; tease; lame.
8. Clock; book; take.
9. Away; savour; fir.

Complete the last word so that it rhymes with the other two in the group:

10. Views; news; q—.
11. Buyer; higher; c—.
12. Waist; haste; r—.

ANSWERS

1. B (or P).
2. F.
3. S.
4. 8.
5. 3.
6. 18.
7. Tea; lease; same.
8. Block; look; cake.
9. Sway; favour; air.
10. Queues.
11. Choir, or crier.
12. Raced.

BRAIN ? BOX

1. A certain snail decided to climb a 6-ft. wall. It climbed up 3 ft. by day, but unfortunately it slipped back 2 ft. each night.

   How many days did it take the snail to reach the top of the wall?

2. (*a*) Convulsive movement;
   (*b*) Glazier's cement;
   (*c*) Rose-petal oil;
   (*d*) Step;
   (*e*) Wise Man's gift.

   These are clues to five five-letter words.

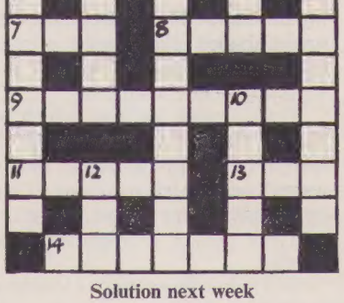
   Draw a 25-square square, 5 by 5. The answers to the above clues can be fitted into this frame, each word being used twice, across and down.

3. Glasgow has something in common with Copenhagen, Moscow, and the coast of Labrador. Can you say what?

ANSWERS

1. Four days.
2. S P A S M
   P U T T Y
   A T A R
   S T A I R
   M Y R R H
3. The same approximate latitude.

HIGH-SPEED CROSSWORD



Solution next week

Clues Across

1. Sun spot (7).
7. Liquid fuel (3).
8. Commerce (5).
9. Revered (9).
11. This is one; two more will indicate spirit of rejoicing (5).
13. Scottish town, seaside resort, and county (3).
14. The work of —— is the concern of our hospitals (7).

Clues Down

2. Play parts (5).
3. *Murder in the* —— is a famous play (9).
4. This river flows into the Thames (3).
5. When this, a sum gets a tick (7).
6. They carry the coal for steam locomotives (7).
10. This follows one of 6 down (5).
12. River for Somerset and Devon (3).

SOLUTION TO LAST WEEK'S CROSSWORD

ACROSS: 5, Need; 7, Item; 8, Geese; 9, Lane; 11, Final; 12, Plan; 13, Tends; 16, Mead; 17, Sage.

DOWN: 1, End; 2, Peg; 3, Steal; 4, Amber; 6, Defined; 7, Islands; 10, Spume; 11, Fatal; 14, Sad; 15, Den.

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include rubber swim-fins shaped like duck's feet which help him to move through the water; a face mask covering eyes and nose and allowing him to see underwater through a flat pane of glass; a depth gauge, wrist-watch, knife, compass, and snorkel (a short breathing tube with a mouthpiece), and a self-inflating rescue device. In cold water a tight-fitting rubber suit is worn, which is flexible and protects the wearer from the worst of the cold.

Water polo

Water polo, a game for swimming enthusiasts, is one of the several sports which have had their origin in Great Britain, where it was invented in about 1880.

It is now a highly competitive international game, providing great excitement for spectators as well as players.

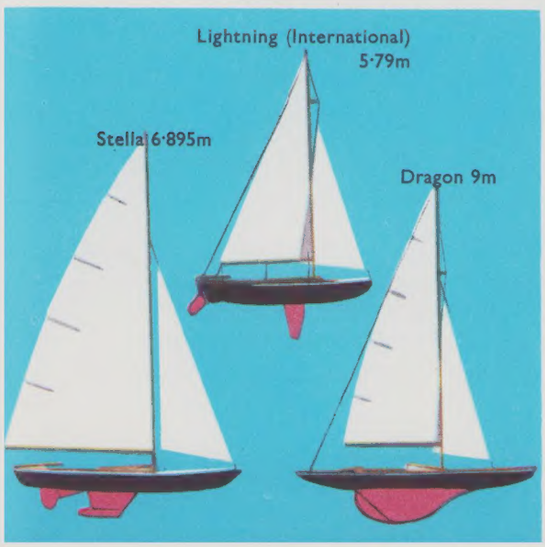
In each team there are seven players – a goalkeeper, two backs, one half-back, and three forwards – and the object of the game is to throw the ball into the opponents' goal, each goal being 10 feet wide and 3 feet above the water.

Sailing

The sport of sailing for pleasure seems to have been born in Holland towards the middle of the 17th century, when the Dutch, who were very skilful navigators, began to build pleasure boats. These they called 'yachts' (which comes from the Dutch word *jaghten*, 'to hunt').

Not a great deal is known about British yachts before the 18th century, when the sport of racing small sailing vessels against each other on the river Thames was greatly

Sailing boats like these are classed according to their dimensions



This skin diver is about to enter the water; his rubber suit will protect him from cold

encouraged by the Duke of Cumberland. In 1775 the River Thames Yachting Club was established, and by this time there were a number of small sailing vessels on the river Thames. The sport also began to develop at Cowes on the south coast, and as early as 1778 there was a race held round the Isle of Wight.

Opportunities for sailing now exist in many parts of Britain, following the great increase in popularity of this sport since the Second World War. Boats are of many classes according to their size and dimensions. Among the smallest in size are the dinghy, the 'stars', the 'snipes', and the 'lightnings'. Larger boats take part in races, in the open sea, which may last for several days.

Skiing

Skiing in Britain takes place for the most part only in Scotland, and many British people go abroad for this sport to countries with ideal climates and conditions for skiing, such as Norway, Switzerland, and Austria.

The world's first skiers probably existed 5,000 years ago in Scandinavia, but skiing did not become a competitive sport until late in the 19th century, not long after the invention in 1880 of ski bindings, the devices which attach the ski boots to the skis.

There are two distinct kinds of competitive skiing, each requiring its own particular kind of landscape, and each named after the area of its development; these are the Nordic and the Alpine. The Nordic competitions consist of long-distance races (about 12 miles), and jumping competitions which take place on specially prepared jumping hills. The Alpine competitions are the downhill and the *slalom* races. A modern slalom race (as it was thought out by an Englishman named Arnold Lunn) is a race down a course defined by pairs of flags, through which the competitor has to pass. The pairs are arranged to test the skier's skill in turning sharply while travelling at high speed.

Skating

In some of the world's museums there still exist examples of bone skates believed to be at least 2,000 years old, and, like skiing, skating seems almost certainly to be of Scandinavian origin. An important advance towards modern skating was the invention in the United States in 1850 of the first all-iron skate. The building of artificially refrigerated ice-rinks has meant that skaters no longer have to wait for cold weather but can practise their sport in all seasons. The first artificial ice-rink was built in England in 1876.

Competitive ice skating is made up of four major variations – solo figure skating, pair skating, ice dancing, and speed skating. Speed skating is by far the oldest form of the sport, and in international championships is carried out over four distances – 500, 1,500, 5,000, and 10,000 metres. Speed skaters are said to be the fastest self-propelled humans in the world, averaging about 25 m p h over a distance of a mile.

In figure and pair skating, skaters have to perform exercises of skill and elegance, while in ice dancing, skaters dance compli-

(*Left*) *Making sure a ski is the correct length;* (*right*) *a competitor in a 'slalom' race*

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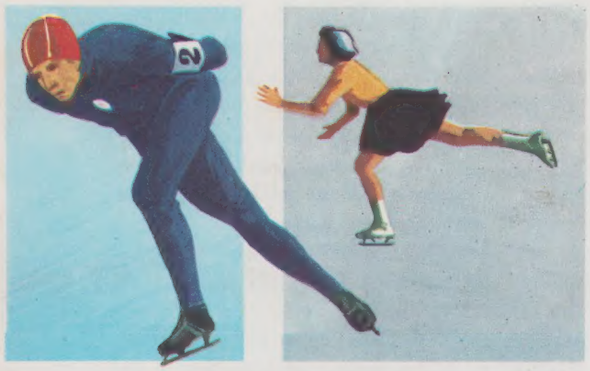

(Left) A skater in a speed race; (right) free skating

cated sequences as gracefully as ballet dancers.

Bobsleigh

Tobogganing is a very popular sport in Britain when there is enough snow, and it has been popular in countries with suitable weather for many centuries. The bobsleigh originated in Switzerland in about 1890. It travels on runners like a toboggan, but has two pairs of runners instead of two single runners, for extra speed. There are two types of bobsleigh: the two-man boblet, and the four-man bobsleigh. A race consists of four descents by each team down the bobrun, and the team with the fastest total time for the four heats is the winning team. Four-man bobsleighs can reach speeds of 70 to 80 m p h.

Curling

Some historians believe this sport to have originated in Holland some 400 years ago, but it has been most popular in Scotland, where it has been played since the beginning of the 17th century.

Curling is played on ice with disc-shaped stones. Each stone has a handle on top with which it is propelled along the ice towards a series of concentric circles or bands of colour called the 'house'. There are two teams of four players each, and each person plays two stones. A team scores 1 to 8 points according to the number of its stones that lie nearer the centre of the house than any of its opponent's. After the moving stone has passed the middle of the rink, the ice in front of it can be swept; this can take a stone an extra 5 or 6 yards and is called *sooping*.

A tense moment during a curling match in Switzerland

Kart racing; this inexpensive sport has recently become enormously popular

Motor-cycling

As early as 1902, British motor-cycles were putting up good performances in Royal Automobile Club trials, and in 1904 the Motor Cycling Club organised their first London to Edinburgh run, the earliest motor-cycling contest in the world. In 1907 the first of the long series of Isle of Man Tourist Trophy races was held; these have become the leading sporting competition in the motor-cycle world.

Another form of motor-cycle sport which is very popular is Speedway, which came to this country from Australia in 1928. At first it was known as dirt-track racing. There are also many motor-cycling enthusiasts for rough-country racing, which developed out of grass racing, and for the thrills of 'scrambling' up very steep courses over rough ground. This calls for great skill from the rider to control his machine.

Motor-cycle engines vary in power according to the size of their cylinder, and competition is organised for the various classes of engine (125, 250, 350, and 500 c c). In addition to solo motor-cycle racing, races are organised for motor-cycles with sidecars and passengers.

Motor racing

The first motor race took place in France between Paris and Rouen in 1894, and was won by the Count de Dion at a speed of 11·6 m p h. After a few years races such as this one, over public roads, were stopped, because of the danger to spectators.

In 1900 the Gordon Bennett Cup Races were started, in an effort to make motor racing an internationally competitive sport. These races were replaced in 1905 by the French Grand Prix, and after the First World War several other countries, as well as France, began to hold Grand Prix motor races each year.

A driver needs exceptional skill and judgment to drive a racing car at a speed of around 100 m p h with bends to navigate in competition with other cars.

Motor racing is organised for cars in three main categories. First of all there are racing cars, which are specially built for racing purposes. Only a few copies of any design are made. Such cars have engines of 300 to 400 horse power. Then there are sports cars, which are not designed primarily for racing, but are capable of high speeds. Finally, in tourist class contests, like the Monte Carlo Rally, ordinary cars can be used.

Karting

One of the newest arrivals to the world of sport is Karting. This sport was started in the United States during the 1950's and was established in Britain on a competitive basis by 1960.

The Kart is a four-wheeled vehicle with a small engine and no protective body. Opinions as to the origin of the Kart vary, but one well-supported story states that an American built himself a 'buggy' consisting of four tiny wheels on a steel frame, a seat, and a lawn-mower engine, simply in order to travel around his factory.

The sport already has its own magazines and clubs, and its central organisation is controlled by the Royal Automobile Club.